Operating Manual

UMTS/GSM Mobile Phone Tests

R&S® UPV-K9 R&S® UPV-K91

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ROHDE&SCHWARZ
Test & Measurement

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Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

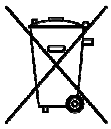
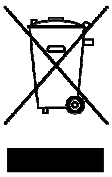
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF supply voltage
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Warning! Hot surface		Alternating current (AC)
	Protective conductor terminal		Direct/alternating current (DC/AC)
	Ground		Device fully protected by double (reinforced) insulation
	Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additonal information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
In the product documentation, the word ATTENTION is used synonymously.

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution severity 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the AC supply network, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the AC supply network. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

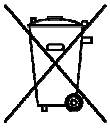
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

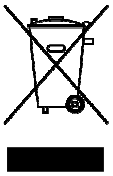
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO — Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.

ADVERTENCIA — Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.

ATENCIÓN — Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.

AVISO — Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.

2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

Quality management and environmental management

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde&Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde&Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear customer,
You have decided to buy a Rohde&Schwarz product. This product has been manufactured using the most advanced methods. It was developed, manufactured and tested in compliance with our quality management and environmental management systems. Rohde&Schwarz has been certified, for example, according to the ISO 9001 and ISO 14001 management systems.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,
Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests de ce produit ont été effectués selon nos systèmes de management de qualité et de management environnemental. La société Rohde&Schwarz a été homologuée, entre autres, conformément aux systèmes de management ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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ROHDE&SCHWARZ

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1 Overview

The acoustic transmission and reproduction quality of a mobile phone is its most important characteristic in everyday use. Even the most visually appealing design and wonderfully sophisticated operating concept are not much use, when the user cannot or can hardly understand what is being said at the other end.

Instruments and methods for measuring acoustic characteristics are therefore essential tools for assessing the quality and suitability of a mobile phone.

These tests are based on standards for 3GPP mobile phones. The test methods are stipulated in 3GPP TS 26.132 and the values to be attained in 3GPP TS 26.131.

As of release 4 of the GSM 51.010 standard (successor to GSM 11.10), even GSM mobile phones may be tested to 3GPP TS 26.132.

The R&S® UPV-K9 and R&S®UPV-K91 options (UMTS/GSM Mobile Phone Tests) of the Audio Analyzer R&S® UPV, called herein below “UPV”, are now available for measuring the acoustic characteristics of UMTS and GSM mobile phones. The measurements are in line with 3GPP TS 26.131, TS 26.132 and TS 51.010 and have been validated by an independent test house for conformance testing on UMTS and GSM mobile phones.

The current version of the software supports 3GPP TS 26.131 and TS 26.132 up to Release 11.

From version 2.3.1.47 of the software, a new “Release” menu is available which allows to determine and start the test cases applicable to a given combination of speech codec bandwidth, type of tested device (handset, headset or handheld, desktop or vehicle-mounted handsfree) and release number of the test specifications.

2 Preparation and Start of the Application Software

Required Measuring Instruments and Accessories

The UPV audio analyzer with the options as described below is required for the measurements.

The mobile phone under test is connected via the RF interface using the Universal Digital Radio Communication Tester R&S CMU200, called herein below R&S CMU200. This tester simulates a base station for the mobile phone so that a call can be set up. For GSM, the R&S CMU200 must be equipped with the options R&S CMU-B21 (signalling unit), R&S CMU-B52 (speech coder/decoder) and the appropriate software options for the GSM band used. For WCDMA (UMTS), the option R&S CMU-B69 is required. Wideband-AMR tests require option R&S CMU-K46 for both GSM and/or WCDMA (UMTS).

Note: *The firmware version in the R&S CMU200 must be 5.04 or higher.*

Acoustic devices such as an artificial mouth, artificial ear and other accessories are required for the measurements. The following equipment from Brüel & Kjær or G.R.A.S. is normally used:

Table 1 Equipment for mobile phone tests

Device	Description	Type (examples)
Telephone test head *(up to Release 8)*	Device for fixing the DUT in the prescribed position	B&K 4602B
Wideband ear simulator *(up to Release 8)*	IEC 711 type occluded ear simulator with adapters for connection to the ear piece of the DUT	B&K 4195 (type 3.2)
Artificial mouth *(up to Release 8)*	Special loudspeaker for simulation of the mouth	B&K 4227 or G.R.A.S. 44AB or 44AA (with power amplifier)
Head and torso simulator	Head and torso simulator with artificial ear (type 3.3) and artificial mouth, may be used alternatively to the abovementioned devices	B&K 4128D
Second (left) artificial ear for head and torso simulator	Required for handsfree tests and adjustment of the background noise field for “speech quality in presence of ambient noise”	B&K 4159C
Handset fixture for Head and Torso simulator	Required to position the handset on the artificial head, and to apply a defined force with the earpiece against the pinna	B&K 4606
Measurement microphone	½” or ¼” measurement microphone for measurement of artificial mouth output during calibration. This microphone can use the preamplifier of the artificial ear type 3.2 if existing. Use a ¼” measurement microphone for calibration of the HATS mouth.	B&K 4191 (free field, may be used for hands free tests), B&K 4192 (pressure field, may be used with type 1 art. ear)
Acoustic calibrator	Sound level calibrator for calibrating the measuring microphone	B&K 4231
Microphone power supply	Power supply and preamplifier for the measuring microphone	B&K 2829, 5935L or 2690A0S2 or G.R.A.S. 12AD or 12AA

Note: *With the amplifier set to 0 dB, the microphone power supply B&K 2690A0S2 produces too much noise for measuring idle noise and distortion. It is therefore advisable to set a gain of 20 dB.*

From Release 9 of TS 26132, the use of the HATS is mandatory for handset and headset measurements. From Release 10, only artificial ear type 3.3 (anatomically shaped soft pinna) may be used.

A cable with a BNC connector and special small or angled banana plugs is required for connecting the P.51 artificial mouth, as the space between the mouth connectors and the LRGP test head (B&K 4602B) is too small for common banana plugs.

The transformer supplied with option R&S UPV-K9 can only be used with the MMS test signal. It must be connected between generator output 1 of Audio Analyzer R&S UPV and the connector of the artificial mouth. The transformer matches the impedance of the loudspeaker in the artificial mouth to that of the generator output of the R&S UPV. Without this transformer, the available power is too low for driving the artificial mouth.

Alternatively, a power amplifier, preferably with a voltage gain of approx. 0 dB, can be connected between generator output and mouth instead of the transformer. In this case, the gain set must be kept absolutely stable after calibration. For tests using artificial voice according to ITU-T P.50 or real speech according to ITU-T P.501, a power amplifier is required. It may also be required for high-level activation signals with high crest factor.

A cable with male (analyzer) and female (generator) XLR connector is supplied for connection to the "Speech" connector of the Digital Radio Communication Tester R&S CMU200.

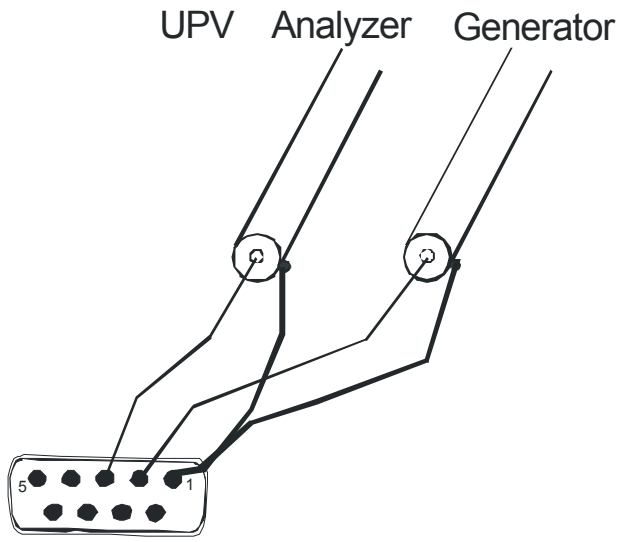


Fig. 1 Assignment of 9-contact speech connector on CMU front panel

This cable is configured for connection to link handler #1 in the R&S CMU200. Depending on the CMU hardware, link handler #2 in the R&S CMU200 can also be used for GSM; in this case, the supplied adapter must be inserted between the cable and the speech connector on the R&S CMU200.

Note: *If the CODEC calibration fails, the adapter has most likely to be inserted.*

Note: *The R&S CMU200 connects pin 1 of the R&S UPV generator output to the equipment grounding conductor of the mains. If an external power amplifier is used, care must be taken that the external power amplifier does not connect R&S UPV generator output pin 2 to the equipment grounding conductor of the mains. If available, a balanced connection to the power amplifier should be preferred.*

Attention: *An external power amplifier should be switched on after the R&S UPV-K9x program has been started, and switched off before the program is ended. This prevents the artificial mouth from undue power loading by setups which are loaded external to the application.*

Note: *An external USB keyboard and a mouse must be connected to the R&S UPV.*

Caution: *R&S UPV-K9x does not support the use of headphones. Do not connect headphones to the R&S UPV during mobile phone tests. High level signals may be present at the headphone connector.*

The UPV audio analyzer must be equipped as follows:

- R&S UPV firmware version 3.3.4.822 or higher.
- License Key R&S UPV-K9 installed.
- License Key R&S UPV-K91 installed.
- For use of test signal according to ITU-T P.50 and distortion tests with CSS or customer specific activation signal License Key R&S UPV-K9101 or higher must be installed.
- For the use of requirements and test methods according to Release 10 of TS 26.131 and TS 26.132, License Key R&S UPV-K9102 must be installed.
- For the use of requirements and test methods according to Release 11 of TS 26.131 and TS 26.132, License Key R&S UPV-K9103 must be installed.
- License Key R&S UPV-K9102 includes R&S UPV-K9101
- License Key R&S UPV-K9103 includes R&S UPV-K9102 and R&S UPV-K9101
- For testcases 7.11 and 8.11 of Release 11 (“echo control characteristics”), option UPV-B3 (second analog generator) is required.

For testcases 7.12 and 8.12 of Release 11 (“speech quality in the presence of ambient noise”) the following additional equipment and options are required:

Description	Instrument Type	Ordering Number
R&S® UPV-K98	Background noise control software acc. ETSI ES 202 396-1	1424.2003.02
R&S® UPV-K101	Measurements using background noise acc. ETSI TS 103 106 and EG 202 396-3	1424.2203.02
R&S® UPP200	Audio Analyzer two channels	1411.1003.02
R&S® UPP-B8	Eight-channel generator	1411.2700.02
R&S® UP-Z8A	8-channel analog cable for R&S®UPP-B8	1411.3206.02

The following equipment not supplied by Rohde & Schwarz is also required:

Device	Description	Type (examples)
2 Pairs of full-range speakers	Frequency response at least 100 Hz to 10 kHz	Behringer Truth B2031A
Subwoofer	Frequency response at least 40 Hz to 120 Hz	M-Audio SBX-10
5 Speaker cables	XLR male – XLR female length approx. 10m	
4 Speaker stands	The base plane of the speaker should be adjustable such that the tweeter of the speaker is at the same height as the artificial ears of the head-and-torso simulator. With the B2031A speakers, the tweeter is about 31 cm above the base. With the Bruel & Kjaer HATS, the entrance of the artificial ear is about 60 cm above the base.	

Installing the Software

The application program requires license keys R&S UPV-K9 and R&S UPV-K91 to be installed. The application program and the license keys are installed together with license key R&S UPV-K9103 in the factory in case a new R&S UPV is ordered together with these options. If the options are ordered separately, the license keys as well as the installation instructions are part of the delivery.

The program required and the associated files are in the folder “UPV-K9x Software” on the installation CD supplied with the R&S UPV-K91 option. It is recommended to copy the files MCRInstaller.exe, CRRuntime_12_3_mlb.exe, RsVisaTarget.msi, UPV-K9x_30356.msi, Config.ini, dotnetfx35.exe and Settings.ini from the folder “UPV-K9x Software” on the installation CD to drive D: on the R&S UPV hard disk drive, e.g. to a folder named “D:\R&S Software\UPV-K9x\Version 3.0.3”. Run the file “UPV-K9x_30356.msi” to start the installation. Follow the instructions of the installer on the screen. If prompted to do so, also run “dotnetfx35.exe”. Subsequently, run also “MCRInstaller.exe” and “RsVisaTarget.msi”. MCRInstaller has to be launched in any case, even if the software UPV-K9y for option R&S UPV-K92 or the previous version 2.3.1.47 of R&S UPV-K9x is installed on the R&S UPV, as this software requires a newer version of the Matlab runtime.

Attention: Once installed, the R&S Visa must not be uninstalled.

To have full control over minimized windows, it is recommended to set the windows taskbar to “Auto-hide”, on top of other windows. Right-click on the Windows Start button and click “properties”.

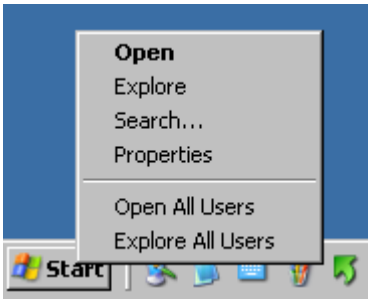


Fig. 2 Context menu for taskbar

In the properties window, click tab “Taskbar” and activate “Auto-hide the taskbar” and “Keep the taskbar on top of other windows”. Click “Apply” and close the window.

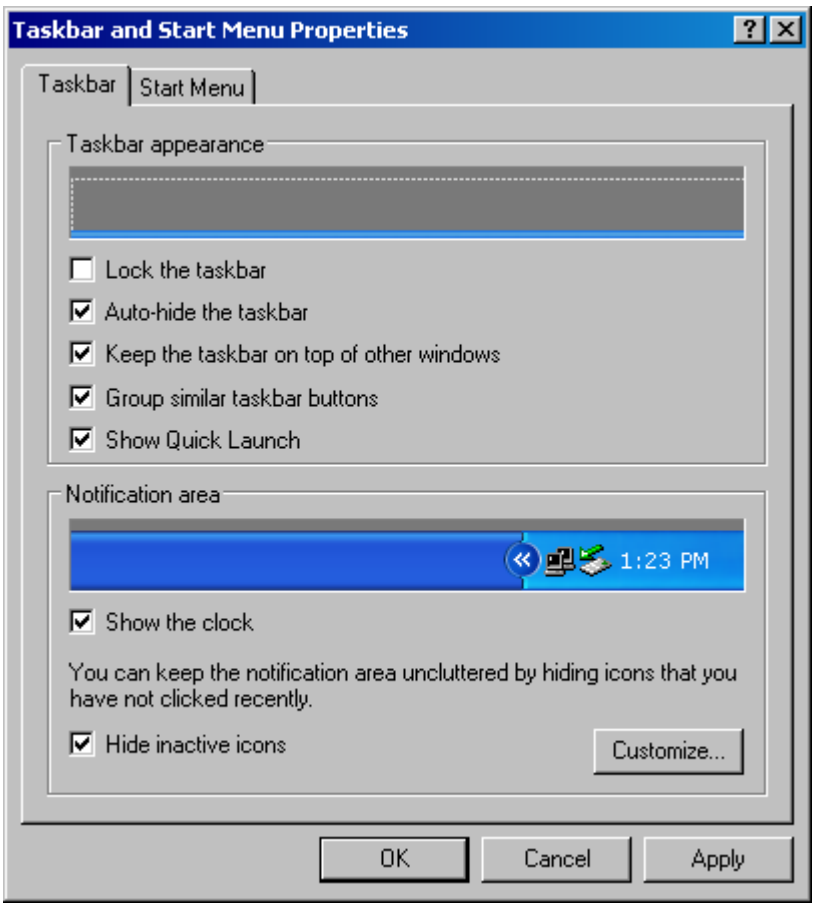


Fig. 3 Properties window for taskbar

Verification of the Installation

After the installation, check the existence of the subfolder “UPV-K9x Mobile Phone Tests” in “C:\Program Files\Rohde&Schwarz”. This subfolder must contain 82 files plus 2 more subfolders.

If the software reports a missing key code at the first start, delete folder “D:\3GPP” (if existing) and install the missing key code before starting the software again.

Test Setup

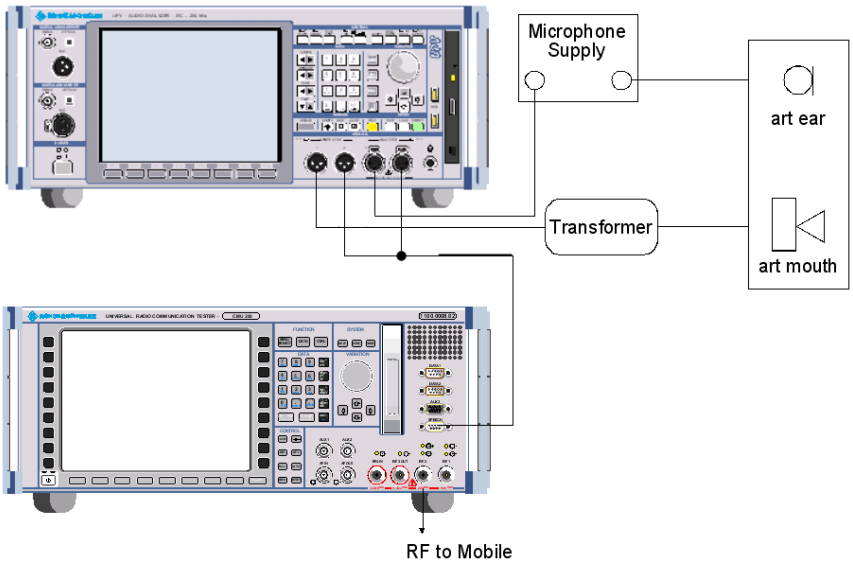


Fig. 4 Test setup and connection of external components

For measurements using artificial voice according to ITU-T P.50 or real speech according to ITU-T P.501, for distortion tests using a composite source signal (CSS) as activation signal and for delay tests with CSS as test signal, the transformer supplied with option R&S UPV-K9 has to be replaced by a (not supplied) external power amplifier. The power amplifier should have a moderate but stable gain between 0 dB and 20 dB and a moderate maximum output power between 5 W and 20 W. It is essential that the gain is not changed between mouth calibration and sending tests.

3GPP TS 26.132 specifies binaural measurement for the test of Handsfree (speakerphone) devices using a head-and torso simulator (HATS). From Release 8, binaural measurement is also foreseen for binaural headsets. The HATS 4128 supplied by Bruel & Kjaer offers an optional left ear simulator 4159C for binaural measurements. The second ear simulator has to be connected to R&S UPV analyzer input 2 for binaural receiving measurements. As this input is also used to connect to the R&S CMU200 decoder output for sending measurements, R&S 3GPP Mobile Phone Tests R&S UPV-K91 support automatic control of an input switcher R&S UPZ. The connection for automatic input switching is done as shown in Fig. 5.

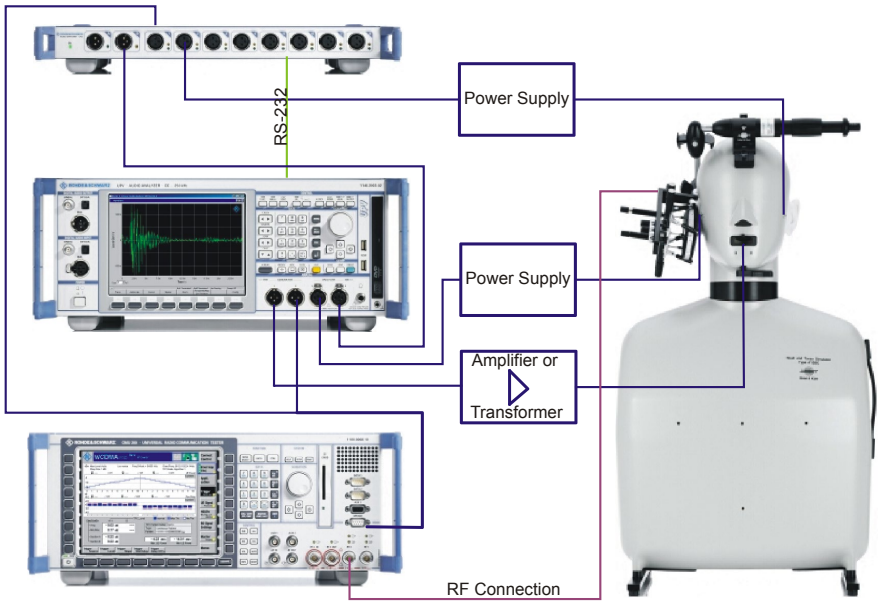


Fig. 5 Test setup and connection of external components for automatic switching

Starting the Application Software

After installation, the program can be started by double-clicking the Icon "UPV-K9x Mobile Phone Tests" or by clicking "R&S UPV Applications → UPV-K9x Mobile Phone Tests" in the "Programs" menu.

At the first start of the program, selection windows appear for the standard according to which the measurements should be made, and for the artificial ear and artificial mouth used.

Fig. 6 Query window for selection of applied standard

If "none" is selected in the standard selection window, all measurements appear in the "Measurement" menu. If a standard is selected, all measurements appear in the "Measurement" menu, but compliant measurements are checked in the menu. If "Allow only selected measurements" is checked, non-compliant measurements are suppressed in the Measurement menu. "Non-standard handset" and "non-standard hands free" select handset or hands-free tests, respectively, which can be customized.

The next window is for selection of relevant measurements according to tested device type, codec bandwidth, test signal and Release of the 3GPP standards TS 26.131 and TS 26.132. All test cases relevant for the selected combination will be offered in the "Release" menu.

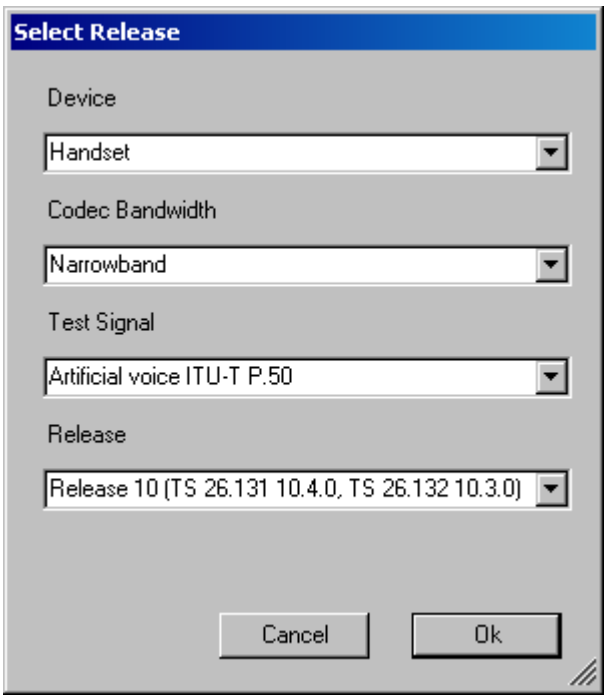


Fig. 7 Query window for the Release menu

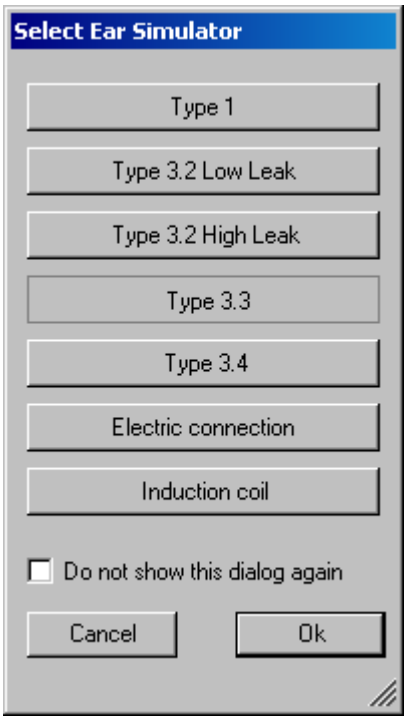


Fig. 8 Query window for selection of artificial ear

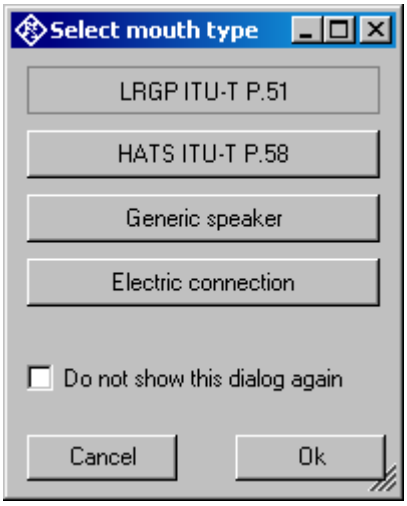


Fig. 9 Query window for selection of artificial mouth

When the checkbox “Do not show this dialog again” is checked, the corresponding selection window will not appear at the program start in future. However, the selection is still available in the “Options” menu (see below). After the last of the four selection windows has been closed, the main window of the R&S UPV-K9 opens.

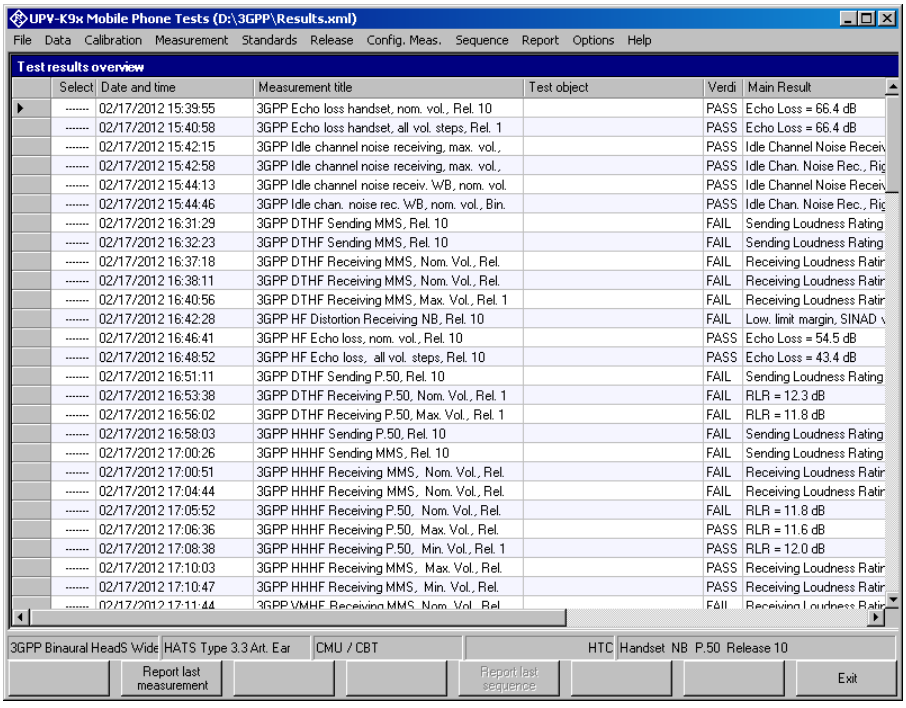

UPV-K9x Mobile Phone Tests (D:\3GPP\Results.xml)
File Data Calibration Measurement Standards Release Config. Meas. Sequence Report Options Help
Test results overview
Select Date and time Measurement title Test object Verdi Main Result
02/17/2012 15:39:55 3GPP Echo loss handset, nom. vol., Rel. 10 PASS Echo Loss = 66.4 dB
02/17/2012 15:40:58 3GPP Echo loss handset, all vol. steps, Rel. 1 PASS Echo Loss = 66.4 dB
02/17/2012 15:42:15 3GPP Idle channel noise receiving, max. vol., PASS Idle Channel Noise Recei
02/17/2012 15:42:58 3GPP Idle channel noise receiving, max. vol., PASS Idle Chan. Noise Rec., Rig
02/17/2012 15:44:13 3GPP Idle channel noise receiv. WB, nom. vol. PASS Idle Channel Noise Recei
02/17/2012 15:44:46 3GPP Idle chan. noise rec. WB, nom. vol., Bin. PASS Idle Chan. Noise Rec., Rig
02/17/2012 16:31:29 3GPP DTHF Sending MMS, Rel. 10 FAIL Sending Loudness Rating
02/17/2012 16:32:23 3GPP DTHF Sending MMS, Rel. 10 FAIL Sending Loudness Rating
02/17/2012 16:37:18 3GPP DTHF Receiving MMS, Nom. Vol., Rel. FAIL Receiving Loudness Ratir
02/17/2012 16:38:11 3GPP DTHF Receiving MMS, Nom. Vol., Rel. FAIL Receiving Loudness Ratir
02/17/2012 16:40:56 3GPP DTHF Receiving MMS, Max. Vol., Rel. 1 FAIL Receiving Loudness Ratir
02/17/2012 16:42:28 3GPP HF Distortion Receiving NB, Rel. 10 FAIL Low. limit margin, SINAD
02/17/2012 16:46:41 3GPP HF Echo loss, nom. vol., Rel. 10 PASS Echo Loss = 54.5 dB
02/17/2012 16:48:52 3GPP HF Echo loss, all vol. steps, Rel. 10 PASS Echo Loss = 43.4 dB
02/17/2012 16:51:11 3GPP DTHF Sending P.50, Rel. 10 FAIL Sending Loudness Rating
02/17/2012 16:53:38 3GPP DTHF Receiving P.50, Nom. Vol., Rel. 1 FAIL RLR = 12.3 dB
02/17/2012 16:56:02 3GPP DTHF Receiving P.50, Max. Vol., Rel. 1 FAIL RLR = 11.8 dB
02/17/2012 16:58:03 3GPP HHHF Sending P.50, Rel. 10 FAIL Sending Loudness Rating
02/17/2012 17:00:26 3GPP HHHF Sending MMS, Rel. 10 FAIL Sending Loudness Rating
02/17/2012 17:00:51 3GPP HHHF Receiving MMS, Nom. Vol., Rel. FAIL Receiving Loudness Ratir
02/17/2012 17:04:44 3GPP HHHF Receiving MMS, Nom. Vol., Rel. FAIL Receiving Loudness Ratir
02/17/2012 17:05:52 3GPP HHHF Receiving P.50, Nom. Vol., Rel. FAIL RLR = 11.8 dB
02/17/2012 17:06:36 3GPP HHHF Receiving P.50, Max. Vol., Rel. PASS RLR = 11.6 dB
02/17/2012 17:08:38 3GPP HHHF Receiving P.50, Min. Vol., Rel. 1 PASS RLR = 12.0 dB
02/17/2012 17:10:03 3GPP HHHF Receiving MMS, Max. Vol., Rel. PASS Receiving Loudness Ratir
02/17/2012 17:10:47 3GPP HHHF Receiving MMS, Min. Vol., Rel. PASS Receiving Loudness Ratir
3GPP Binaural HeadS Wide HATS Type 3.3 Art. Ear CMU / CBT HTC Handset NB P.50 Release 10
Report last measurement
Report last sequence
Exit

Fig. 10 Main window

Initially the data grid in the centre of the screen which shows the result overview is empty. The screenshot in Fig. 10 shows an example after a number of measurements have been made.

By clicking with the right mouse button on the data grid, a context menu opens which allows to create a report of a result marked by a solid triangle in the respective row header, edit the comment for a marked result, to delete the marked result or to export one of the curves in the marked result graph to an ASCII format.

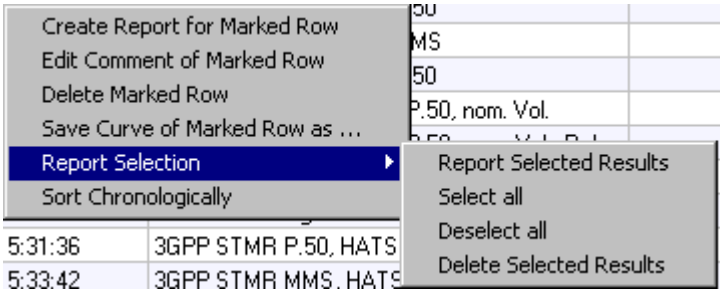


Fig. 11 Context menu of the result data grid

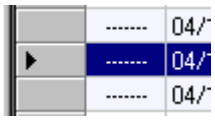


Fig. 12 A triangle in the row header indicates a marked row

The “Report Selection” submenu allows to report on or delete a selection of results which have been marked in the “Select” column of the data grid. To select or unselect a result, click in the “Select” column of the respective row. Selected rows show “XXXXX”, unselected rows show “-------“ in this cell.

If the results have been sorted alphabetically according to one of the columns by clicking on the respective column header, the chronological order can be restored using the context menu item “Sort Chronologically”.

Operating Concept

R&S 3GPP mobile phone tests consist of the main user interface window which allows general settings, calibration routines, data handling, automatic sequencing and reporting tools, and of test macros for basic measurement types defined in the standards. Each measurement type provides a set of parameters (R&S UPV setup files, limits etc.) which are defined in separated measurement definition files, one for each test case.

Attention: *Do not attempt to modify files with extensions “set”, “sup”, “xml”, “cal” “seq” or “mdf”, using a text editor. Any change with a text editor may make the files unusable and cause malfunction of the software.*

Options (General settings)

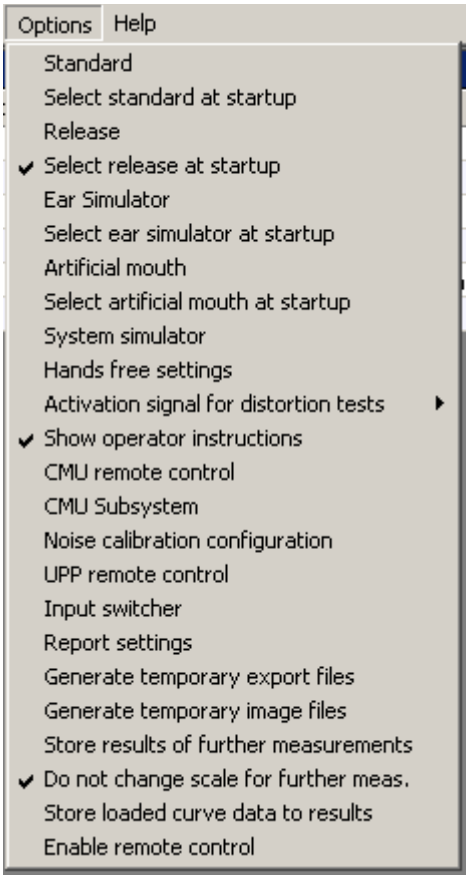


Fig. 13 Options menu

The “Options” menu in the main window allows changing a set of general settings like ear type and mouth type used which are valid for all or at least a plurality of the tests.

Standard

“Standard**”** allows selecting one of the available standards. Measurements belonging to this standard will be checked in the measurement menu. If “Allow only standard measurements” is checked, it is not possible to start single measurements which do not belong to the standard.

Select standard at startup

If **“**Select standard at startup**”** is checked, the selection window for the standard is opened at each start of the program.

Release

“Release**”** opens the window to select type of tested device, codec bandwidth, test signal and Release of 3GPP standards TS 26.131 and 26.132 to be applied. Any change in these settings will re-build the “Release” menu with the applicable test cases.

Select release at startup

If **“**Select release at startup**”** is checked, the selection window for the “Release” menu is opened at each start of the program.

Ear simulator

"Ear simulator**"** allows selecting the type of ear simulator used. For details on the handling of calibration data see section 4 "Calibration" below.

Select ear simulator at startup

If **"**Select ear simulator at startup**"** is checked, the selection window for the ear simulator is opened at each start of the program.

Artificial mouth

"Artificial mouth**"** allows selecting the type of artificial mouth used. For details on the handling of calibration data see section 4 "Calibration" below.

Select artificial mouth at startup

If **"**Select artificial mouth at startup**"** is checked, the selection window for the artificial mouth is opened at each start of the program.

System simulator

"System simulator**"** allows selecting the type of system simulator used. For details on the handling of calibration data see section 4 "Calibration" below.

Hands free settings

"Hands free settings**"** allows selecting the acoustic instruments used for hands free testing. It is possible to use an ITU-T P.51 artificial mouth together with a free field microphone, a HATS with one artificial ear or a HATS with two artificial ears. If two artificial ears are used, the decoder has to be disconnected from analyzer input 2 and the second artificial ear has to be connected to it for receiving measurements. Do not forget to re-connect the decoder for any measurement in sending direction.

Activation signal for distortion tests

In the sub-menu to "Activation signal for distortion tests", signals can be imported to the test system. If more than one imported signal is available, it is possible to choose one of them for actual use.

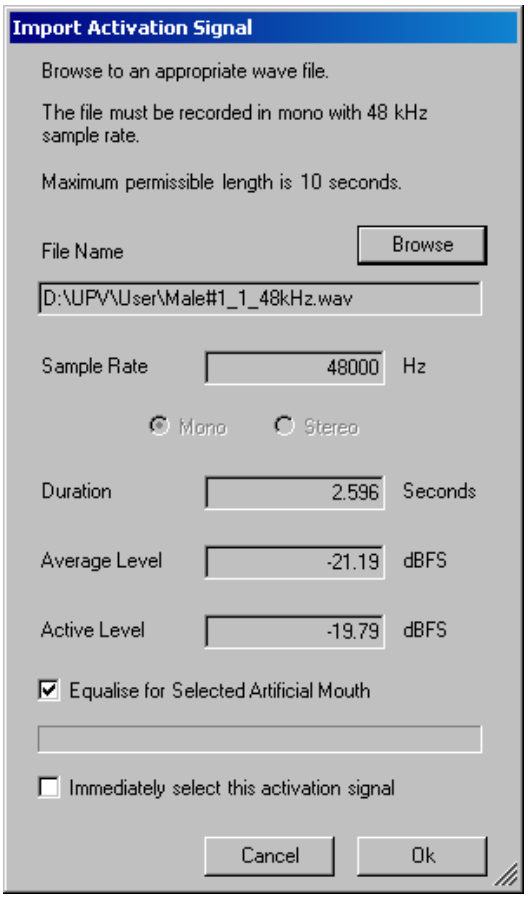


Fig. 14 Window for import of activation signals

Use the “Browse” button to select a wave file which fulfills the conditions shown on top of the window. The selected signal is analyzed and checked for appropriateness. Note that a high crest factor of the signal may overdrive the codec or artificial mouth. If “Equalize for Selected Artificial Mouth” is activated, the file is immediately equalized for the selected artificial mouth when the “Ok” button is clicked. Otherwise or when the mouth calibration has been re-done or a different artificial mouth has been selected in the meantime, the signal is equalized automatically immediately before the sending distortion test starts.

If “Immediately select this activation signal” is checked, the signal is selected for use when the “Ok” button is clicked.

Show operator instructions

If “Show operator instructions**”** is checked, instructions to the operator are displayed in a window before the measurement starts. The operator may be prompted to position the mobile in a defined way or to set the volume to a certain setting.

CMU remote control

If it is intended to remote control a R&S CMU200 from a sequence of this program, menu item “CMU remote control” can be used to select the communication interface (GPIB or RS-232) and, if multiple devices are found, to select one of them.

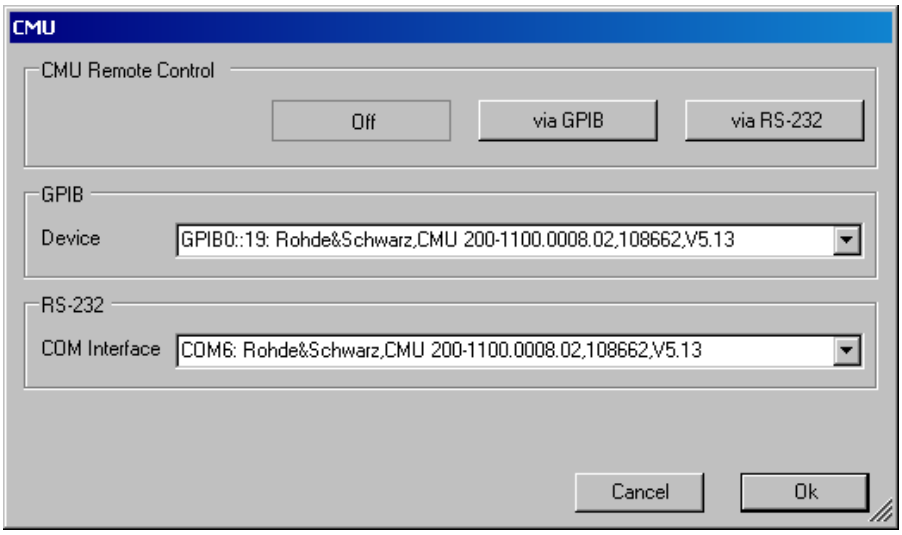


Fig. 15 Window for import setting the CMU remote control

For remote control via RS-232, an external USB-to-serial converter has to be connected and installed. For remote control via GPIB, the R&S VISA has to be installed. The installer for the R&S VISA is distributed with the Option R&S UPV-K91. For details of the remote control see section 8 and the operation manuals of the R&S CMU200.

CMU subsystem

In “CMU subsystem”, one of the communication standards / GSM frequency bands can be selected. This allows sequences to be run in different GSM bands without changing the subsystem in every single CMU control instance in the sequence.

Noise Calibration Configuration

In “Noise Calibration Configuration” parameters for the background noise field used for the “Speech Quality in Presence of Ambient Noise” test can be set.

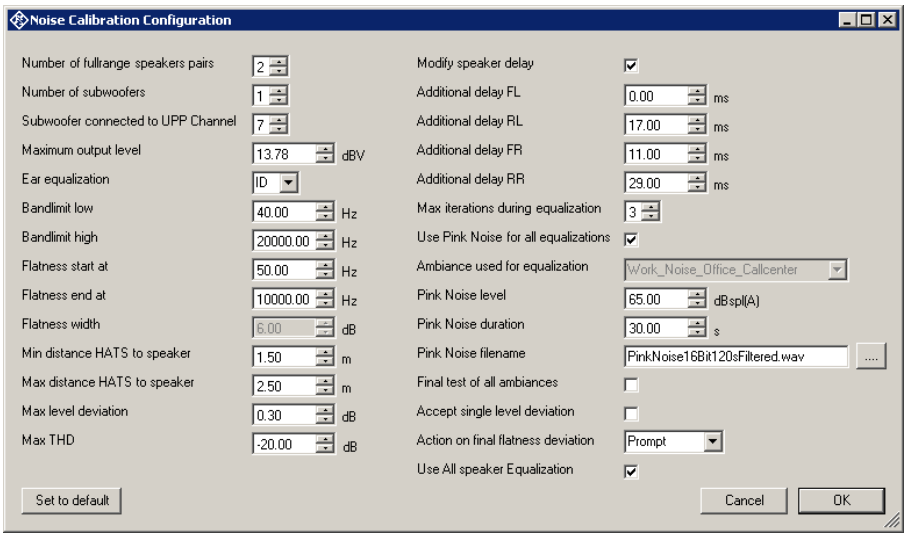


Fig. 16 Window for configuring the background noise calibration

The configuration of the noise field calibration comprises

1. Choice of the calibration method

2. Speaker configuration
3. Bandwidth and tolerance settings
4. Other settings

The configuration is saved in the settings of the UPV-K9x program, so that it has to be done at least once and can then be re-used as long as the speaker configuration and calibration methods do not need to be changed. Section 3.4.3 may be skipped by a non-expert operator.

Equalization method

Three different equalization methods are available with different trade-off between required measurement time and achieved accuracy:

1. Individual equalization and level alignment for each ambient noise condition

The complete equalization procedure is repeated for each ambient noise condition. This allows equalizing individual responses of each noise condition and obtains best matching equalization results. The required measurement time is the highest of all three alternatives and requires at least eight hours.

Fig. 17 Setting for individual speaker equalization of each ambient noise condition

2. Equalization using pink noise and individual level alignment for each ambient noise condition

The room response is measured using stochastic pink noise. The obtained equalization is used for all ambient noise conditions. The stochastic nature of the pink noise ensures that the energy is distributed evenly of the complete bandwidth. Required calibration time is about three hours.

Fig. 18 Configuration of pink noise for speaker equalizations

The level of the pink noise can be chosen between 40 and 70 dBspl(A). For obtaining a similar level as with the noise fields, it should be chosen as 60 dBspl(A) or higher.

The pink noise duration (and averaging time for the measurement) can be chosen between 10 s and 120 s. Recommended duration is 30 s which equals the averaging time for equalization with real ambient noise condition. An increased averaging time increases the accuracy in particular at the low frequency end.

Alternative to the default pink noise file, a user-defined pink noise file can be loaded. It must be located in the working directory (i.e. “D:\3GPP”) and be at least 120 seconds long.

3. Equalization using a selected one of the ambient noise conditions and individual level alignment for each ambient noise condition

This method determines the equalization using one of the available ambient noise conditions as test signal. This equalization is then used for all ambient noise conditions. Only the level is aligned individually for each ambient noise condition. The measurement time is about 3 hours.

Fig. 19 Selection of ambient noise for the speaker equalization

As the result of this method depends on the spectral distribution of the energy in the chosen noise condition, this method cannot be generally recommended.

Speaker configuration

Currently only the following two configurations are supported:

1. Four full-range speakers without subwoofer

Fig. 20 Settings for using four speakers without subwoofer

2. Four full-range speakers with one subwoofer

Fig. 21 Settings for using four speakers with one subwoofer

The speakers have to be connected as follows:

- Full-range speaker front left: UPP generator channel 3
- Full-range speaker rear left: UPP generator channel 4
- Full-range speaker front right: UPP generator channel 5
- Full-range speaker rear right: UPP generator channel 6
- The subwoofer (if existing) can be connected to one of the channels 7 … 9 according to the configuration setting.

Bandwidth and tolerance

The permissible tolerance of the equalized spectrum is stipulated by the standards to be ±3 dB and cannot be changed. For special cases it is, however, possible to raise the lower end of the tolerance template if the room has acoustic drawbacks (standing waves, structure-borne noise) which cannot be improved with acoustic means.

Fig. 22 Bandwidth and tolerance settings

"**Bandlimit low**" limits the transmission frequency range of the speaker setup by applying a highpass filter. This sets the lower end of the equalized frequency range. It is recommended to suppress frequencies below the 50 Hz third octave, which means to set the bandlimit low to about 44.5 Hz. For other third octaves the recommended lower band limit is fc / 1.122 with fc being the center frequency of the third octave. The value of "Flatness start at" is automatically adapted to an increased lower band limit if required.

"**Bandlimit high**" sets the upper frequency limit for the equalization. The default value of 20,000 Hz should not be altered.

"**Flatness starts at**" sets the lower frequency limit for the tolerance check. The standard ETSI EG 202 396-1 stipulates a value of 50 Hz.

"**Flatness ends at**" sets the upper frequency limit for the tolerance check. The standard ETSI EG 202 396-1 stipulates a value of 10,000 Hz.

Ear Equalization

Combobox "**Ear Equalization**" allows to set the equalization for both artificial ears to the equalization applied with the recording of the ambient noise condition.

Fig. 23 Selection of ear equalization

Besides diffuse field equalisation ("DF") and free field equalization ("FF"), a so-called "independent of direction" ("ID") equalization can be applied. This equalization curve must be imported for each artificial ear in use with menu item "Calibration → ID (Independent of Direction) Equalization → ... ".

Fig. 24 Import of ID equalization data

An average ID equalization curve is provided with file "ID_equalization.veq". Alternatively an individually determined curve can be loaded.

If an equalization curve of the chosen type is missing for one of the artificial ears in use, the calibration procedure is aborted with an appropriate error message.

Speaker Distance Range

The following controls allow to specify a restricted range for the distance between each speaker and the artificial ears of the HATS:

Fig. 25 Setting the range for the speaker distance

This allows to detect for example swapped ear connections, because the delay from the speaker to the contra-lateral ear takes a detour over wall reflections. The default values are appropriate for the room size specified in standard ETSI EG 202 396-1.

The distance between full-range speakers and artificial ears is determined by delay measurements. The distance between the subwoofer and the HATS must be measured by the operator and entered in the configuration window.

Level Tolerance

The control

Fig. 26 Control for maximum allowable level deviation

defines the maximum allowable tolerance for the level adjustment. Higher accuracy usually requires more iteration steps (up to 5), and is possibly not even adjustable with this maximum number of iterations. Is the required tolerance not reached, the operator is prompted in a message box whether to start more iterations or accept the tolerance. If the adjustment process is to run automatically without operator interaction, this message can be deactivated with checking tick box “Accept single level deviation”.

Fig. 27 Deactivation of window prompting to accept a level tolerance

Harmonic Distortion Limit

A violation of the harmonic distortion specified in “Max THD” can be a sign for clipping in a speaker due to overrange.

Fig. 28 Entry of THD limit

If a speaker generally has higher distortion, this value can be increased. If a THD value above the specified limit is detected, the operator has the following options:

1. Reduce the gain settings in the speaker and repeat the measurement.
2. Cancel the calibration process, reduce the setting in “Maximum output level” and restart the calibration process.

Fig. 29 Entry of THD limit

3. Accept the observed THD value and continue without modification of parameters.

Additional Delay Modification for Each Speaker

According to ETSI ES 202 396-1, in all test rooms each loudspeaker signal should be delayed additionally with an individual value in order to increase the diffusity of the noise field and avoid comb filter effects. The operator can modify the individual delays which are added to the delays determined in the delay measurement step. Maximum allowed value is 50 ms.

Fig. 30 Entry of additional speaker delay

It is also possible to disable the additional delay. Then only the delays determined in the delay measurement step are applied.

Maximum Iteration Count for Equalization Steps

The following control can be used to set the number of iteration steps for the equalization of individual speakers and of speaker pairs.

Fig. 31 Entry of maximum iteration count

Additional iteration steps improve the equalization accuracy on the cost of increased measurement time. The iteration process continues until either a flatness better than 1 dB is achieved or the maximum number of iteration steps id reached.

More than three iteration steps cannot be expected to improve the equalization significantly. Maximum input number is 5 iterations. A value of 1 disables iteration altogether. In this case the equalization function is calculated from the first measured frequency response.

Final Spectrum Check

If the following tick box is activated, the equalization of all ambiences is finally checked, and the flatness and absolute level difference is determined.

Fig. 32 Checkbox for final equalization test of all ambient noise files

This measurement takes approximately 20 minutes and can also be started after the calibration has been finalized.

The result of this check is stored in the database and appears in the report of the calibration process. A “Fail” in a single ambience only has influence on the total verdict if the ambiences had been chosen to be equalized individually (see above).

Refinement of Total Spectrum Equalization

Activating the following tick box enables an algorithm which tries to improve the result of the total equalization into a tolerance scheme of ±3 dB.

Fig. 33 Activating refinement of the total spectrum equalization

This is attempted by a re-equalization of single speakers. This algorithm requires at least 1 hour in addition to the preceding adjustment process and is not in all cases successful. Alternatively it is recommended to optimize the speaker positioning in the room and re-run the adjustment process

Minimizing Operator Interaction

After the initial plausibility check and delay measurements it is desirable to run the calibration process without operator supervision. The settings required for this must be made before starting the calibration process.

A “Fail” of the final check of the total equalization may be caused by an unexpected background noise in the test room. In this case it is possible to repeat the check to avoid an immediate fail.

The combo box “Action on final flatness deviation” allows the operator to select the action to be taken in case of a failing final check of the total equalization.

Fig. 34 Selection of the action performed if the final equalization check fails

“Prompt” leads in case of a fail to a message box where the operator can choose

1. to repeat the final check
2. to cancel the calibration process in order to improve the acoustic properties of the speaker setup in the room, or
3. continue the measurement with this check being finally failed.

Choose “Retry once” or “Retry twice” for unattended operation.

UPP Remote Control

This dialog allows to detect and connect a UPP with option UPP-B8 on the LAN, to be used as playback system for the background noise generation.

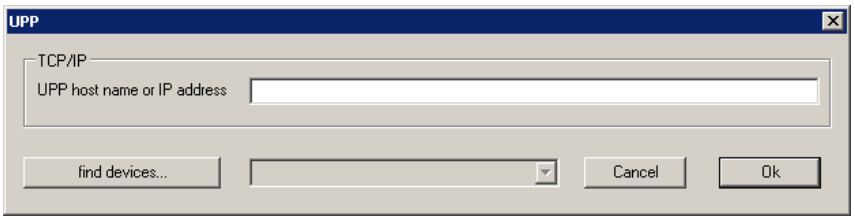


Fig. 35 Window for connecting to a UPP on the LAN

A click on the “find devices...” button searches the local area network for audio analyzers and fills the combobox next to the button with the computer names and IP addresses of the found devices. Select the appropriate instrument in the combobox and click “Ok”.

Input Switcher

“Input Switcher” allows to configure the use of a R&S UPZ input switcher connected to the R&S UPV RS-232 port, to switch analyzer input 2 between sending tests and binaural receiving tests.

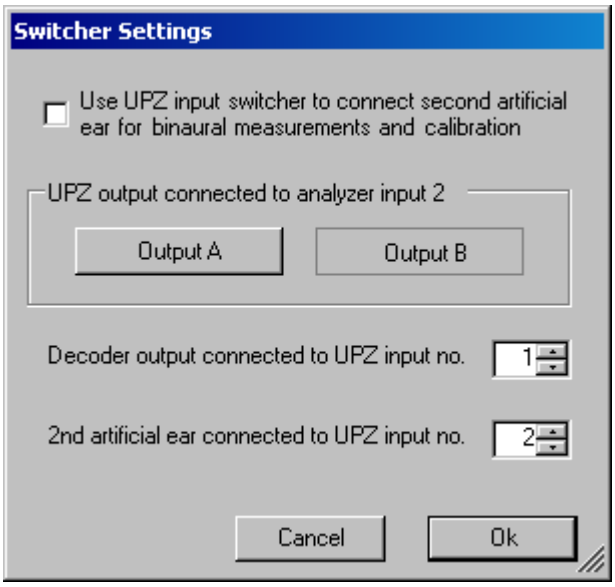

Switcher Settings
Use UPZ input switcher to connect second artificial ear for binaural measurements and calibration
UPZ output connected to analyzer input 2
Output A
Output B
Decoder output connected to UPZ input no.
1
2nd artificial ear connected to UPZ input no.
2
Cancel
Ok

Fig. 36 Switcher window

Report settings

“Report settings**”** allows to define the type of information which should appear in the reports. For details on reporting, see section 8 below.

Generate temporary export files

If **“**Generate temporary export files**”** is checked, some of the measurement macros create “result.exp” with result value and verdict, and, if applicable, “curve.exp” or “abscurve.exp” and “relcurve.exp” files with curve data in ASCII format. This function is provided for compatibility with R&S UPL-B9.

Generate temporary image files

Item **“**Generate temporary image files**”** causes the measurement macros to store a screenshot of the measurement window after completion of the test to a file “Image.TIF” for use by a remote controlling host.

Store results of further measurements

If “Store results of further measurements**”** is checked, curves and calculated values like loudness ratings are also stored for additional measurements started with the “Add Measurement” key. They will appear in reports of the respective measurements.

Do not change scale for further meas.

Menu item “Do not change scale for further meas.” deactivates the automatic Y-axis scaling if the curve of an additional measurement leaves the plot area partially or totally.

Store loaded curve data to results

If “Store loaded curve data to results**”** is checked, curves loaded from file with the “Load Curve” softkey are stored to the results database and will appear in reports of the respective measurements.

Enable remote control

Menu item “Enable remote control**”** activates the interface of the program for remote control using the client “ControlK9.exe”.

3 Calibration

Calibration Devices

R&S UPV-K9 allows to simultaneously store calibration values for multiple individuals of the same type. This allows to switch devices without the requirement for re-calibration. However, regular re-calibration is recommended in order to assure the correct function of the used devices.

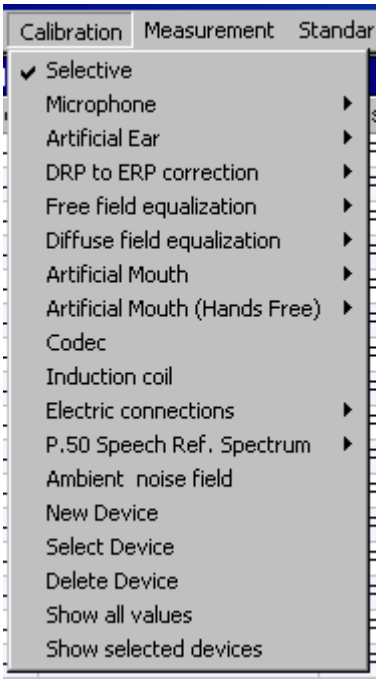


Fig. 37 Calibration menu

For every device to be calibrated, an entry must be created using “Calibration → New device” in the main menu. This menu item opens an entry window to specify the calibrated device. A category of device must be chosen from the combo box on top. Type, manufacturer and serial number are entered into the text boxes below. The entries are confirmed by clicking on the “Save and close” button. If the box “Immediately select this device” is checked, the device is selected for immediate use with the “Save, select and close” button.

For ease of use, a “default” device is present and selected for each device type (category) upon first start of the program.

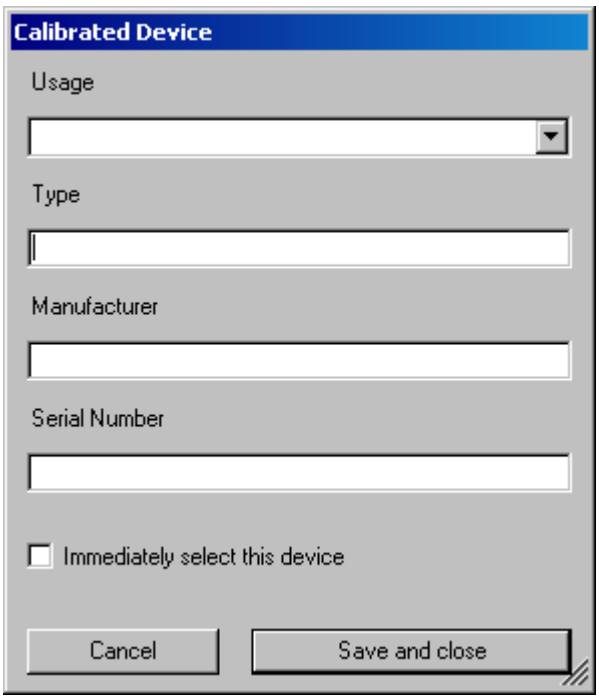


Fig. 38 Input window for information about calibrated device

Before a device can be calibrated or used, it must be selected. This can be done from the “Calibrated Device” input window if the checkbox “Immediately select this device” is checked. Existing devices may be selected with “Calibration → Select device” in the main menu. Clicking on this item opens a window with a table of all entered devices.

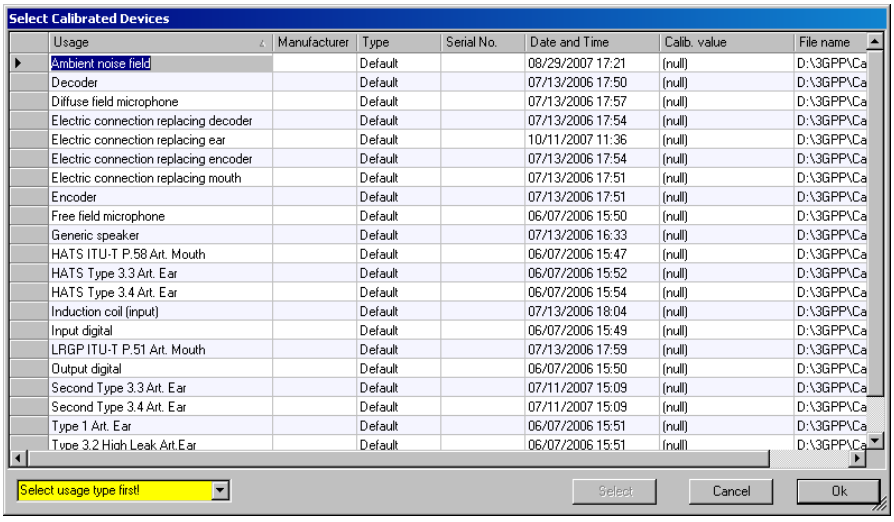


Fig. 39 Window for selection of calibrated devices

In the combo box lower left, a category of devices must be selected. Subsequently the table is reduced to available devices in this category. At first startup, there is only a “Default” device for each category, but when more devices have been created with the “New device” function, a choice will be available in this view. In this state a row in the table can be marked with a mouse click on its left end. A mouse click on the button “Select” selects this device for the associated usage.

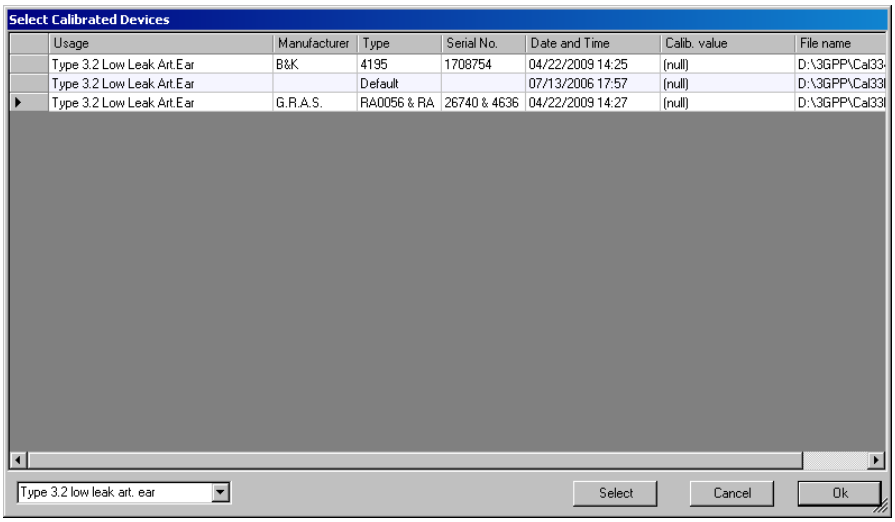


Fig. 40 Selection window for particular device type

Subsequently this procedure may be repeated for other categories. Finally all selections are confirmed by clicking the “Ok” button.

A calibrated device may be deleted, using menu item “Calibration → Delete device”. The device to be deleted must not be selected for use. Another device of the same type must be selected before the device can be deleted. Select the device to be deleted the same way as in the preceding paragraph the device to be used. Note that all calibration information is deleted for this device except result data required for reporting previous test results.

All calibration data are stored on the R&S UPV hard disk and are therefore automatically available again after every restart. The calibration values for the R&S UPV-K91 option are stored independently of other options. Calibration values for 3GPP tests and CDMA2000 tests are handled separately.

All calibration routines below require as pre-requisite that a device for the respective usage has been generated and selected.

To simplify the procedure for the case that it is not intended to use multiple devices of the same category nor to include information about the used devices into a report, there is a “Default” device selected for each device type or category after the first start of the program.

An overview of all selected calibration devices together with the calibration values is given under the menu item “Calibration → Show selected devices”.

Microphone Calibration

- **Insert the measuring microphone fully into the adapter of the sound level calibrator and switch on the calibrator. A ½" adapter or ¼" adapter is required according to the microphone diameter.**

  Note: *After inserting the microphone, wait about 10 s to allow for static pressure equalization.*

- **Call the test routine with "Calibration → Microphone → Free field" or "Calibration → Microphone → Diffuse field" from the main menu, depending on the microphone.**

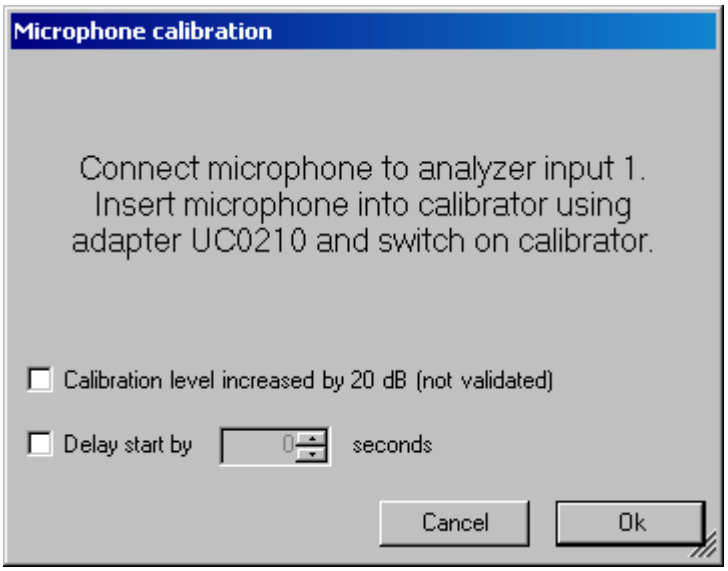


Fig. 41 Initial window of microphone calibration

For calibrators providing a sound pressure level of 114 dB (10 Pa), the checkbox "Calibration level increased by 20 dB" must be checked. In all other cases the checkbox must remain unchecked! If a calibrator with a frequency other than 1000 Hz is used, make sure that the "Selective" item in the Calibration menu is unchecked.

The output voltage of the microphone is measured and the sensitivity displayed with reference to 1 Pa. If a mere power supply without gain is used, the displayed sensitivity must approximately match the value in the calibration certificate of the microphone cartridge (typical value for microphone capsule 4134 of artificial ear 4185 is approx. 12 mV/Pa). If a conditioning amplifier with 20 dB gain (recommended value) is used, the displayed sensitivity must be about 10 times higher (e.g. 120 mV/Pa). If the voltage measured is below 3 mV, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before starting the calibration again.

Calibration of Artificial Ear

Prior to the measurements, the absolute sensitivity of the microphone in the artificial ear must be determined using a sound level calibrator such as the Brüel & Kjær 4231 with a sound pressure level of 94 dBSPL or a sound pressure of 1 Pa at 1 kHz.

Calibration of Ear Type 1

- **Switch off the microphone power supply.**

  Attention: *The 200 V polarization voltage of the microphone may cause a slight electric shock. The current is harmless, but the microphone preamplifier may be damaged.*

- **Remove the microphone from the artificial ear.**
- **Screw back the microphone capsule and switch on the operating voltage.**
- **Insert the microphone fully into the adapter of the sound level calibrator and switch on the calibrator.**

  Note: *After inserting the microphone wait about 10 s to allow for static pressure compensation.*

- **Select "Calibration → Artificial ear → Type 1" from the main menu.**

  For calibrators providing a sound pressure level of 114 dB (10 Pa), the checkbox "Calibration level increased by 20 dB" must be checked. In all other cases the checkbox must remain unchecked!

  The output voltage of the microphone is measured and the sensitivity displayed with reference to 1 Pa. If a mere power supply without gain is used, the displayed sensitivity must approximately match the value in the calibration certificate of the microphone cartridge (typical value for microphone capsule 4134 of artificial ear 4185 is approx. 12 mV/Pa). If a conditioning amplifier with 20 dB gain (recommended value) is used, the displayed sensitivity must be about 10 times higher (e.g. 120 mV/Pa). If the voltage measured is below 3 mV or fluctuating by more than 0.2 dB, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before restarting the calibration.

  The reference value measured is stored in a file on the hard disk and used for all subsequent measurements when the same artificial ear type 1 is used as currently selected.

Calibration of Ear Type 3.2 Low Leakage

- **Connect the sound level calibrator tightly to the artificial ear using the adapter DP0939 and switch on the calibrator.**
- **Select "Calibration → Artificial ear → Type 3.2 Low Leak" from the main menu.**

  For calibrators providing a sound pressure level of 114 dB (10 Pa), the checkbox "Calibration level increased by 20 dB" must be checked. In all other cases the checkbox must remain unchecked!

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the voltage measured is below 3 mV or fluctuating by more than 0.2 dB, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before restarting the calibration.

The measured reference value is stored in a file on the hard disk and used for all subsequent measurements when the same ear type 3.2L is used as currently selected.

Reading the DRP-ERP Correction Data of the Artificial Ear of Type 3.2L:

The frequency response of the artificial ear of type 3.2L is supplied on a floppy together with the artificial ear. The data is used for transforming the measurement values from the drum reference point to the ear reference point.

- Connect a USB floppy disk drive with the calibration disk to the R&S UPV, copy the file "OES_LL.ADA" from the manufacturer's calibration disk to a USB stick or a CD-ROM or make this file available on a network drive via LAN**.**
- Call the routine "Calibration → DRP to ERP Correction → Type 3.2 Low leak". Browse to the file "OES_LL.ADA" and click "Open".

  The calibration file is read. The modified data is stored on the R&S UPV hard disk. This procedure needs only be repeated after a change of the calibration data, e.g. after a recalibration of the ear by the manufacturer, or when the "3GPP" directory has been renamed or removed.

Calibration of Ear Type 3.2 High Leakage

- **Connect the sound level calibrator tightly to the artificial ear using the adapter DP0939 and switch on the calibrator.**
- **Select "Calibration → Artificial ear → Type 3.2 High Leak" from the main menu.**

  For calibrators providing a sound pressure level of 114 dB (10 Pa), the checkbox "Calibration level increased by 20 dB" must be checked. In all other cases the checkbox must remain unchecked!

  The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the voltage measured is below 3 mV or fluctuating by more than 0.2 dB, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before restarting the measurement.

  The measured reference value is stored in a file on the hard disk and used for all subsequent measurements when the same ear type 3.2H is used as currently selected.

  Reading the DRP-ERP Correction Data of the Artificial Ear of Type 3.2H:

  The frequency response of the artificial ear of type 3.2H is supplied on a floppy together with the artificial ear. The data is used for

transforming the measurement values from the drum reference point to the ear reference point.

- **Connect a USB floppy disk drive with the calibration disk to the R&S UPV, copy the file "OES_HL.ADA" from the manufacturer's calibration disk to a USB stick or a CD-ROM or make this file available on a network drive via LAN.**
- **Call the routine "Calibration → DRP to ERP Correction → Type 3.2 High leak". Browse to the file "OES_HL.ADA" and click "Open".**

  The calibration file is read. The modified data is stored on the R&S UPV hard disk. This procedure needs only be repeated after a change of the calibration data, e.g. after a recalibration of the ear by the manufacturer, or when the "3GPP" directory has been renamed or removed.

Calibration of Ear Type 3.3

- **Remove the pinna from the artificial ear according to the manufacturer's instructions**
- **Connect the sound level calibrator tightly to the artificial ear using the adapter UA-1546 and switch the calibrator on.**
- **Select "Calibration → Artificial ear → HATS Type 3.3" from the main menu.**

  For calibrators providing a sound pressure level of 114 dB (10 Pa), the checkbox "Calibration level increased by 20 dB" must be checked. In all other cases the checkbox must remain unchecked!

  The type 3.3 ear calibration requires the calibrator with adapter UA-1546 to be held manually against the ear. If the HATS is installed remote from the R&S UPV, the checkbox "Delay start by … seconds" can be checked and a time interval can be entered by which the start of the calibration measurement is delayed. The countdown is displayed on the R&S UPV screen.

Fig. 42 Ear calibration window with delayed start

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the voltage measured is below 3 mV or fluctuating by more than 0.2 dB, an error message is displayed. Possible error sources are, for example, a switched-off

microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before restarting the calibration.

The measured reference value is stored in a file on the hard disk and used for all subsequent measurements when the same ear type 3.3 is used as currently selected.

Reading the DRP-ERP Correction Data of the Artificial Ear of Type 3.3:

Call the routine "Calibration → DRP to ERP Correction → Type 3.3 →From ITU-T P.57 Table 2b". This procedure needs only be repeated when the "3GPP" directory has been renamed or removed.

Alternatively it is also possible to load individual DRP-ERP correction data from a calibration disk. This option is not conformant with the standards.

Reading the Diffuse Field Equalization Data of the Artificial Ear of Type 3.3:

From Release 10 of 3GPP TS 26.132, diffuse field equalization is applied to receiving frequency response results with handset and headset UEs. Call the routine "Calibration → Diffuse field equalization → Type 3.3 →From ITU-T P.58 Table 3". This procedure needs only be repeated when the "3GPP" directory has been renamed or removed.

Alternatively it is also possible to load individual diffuse field equalization data from a calibration disk. This option is not conformant with the standards.

Calibration of Ear Type 3.4

- **Remove the pinna and the ear canal simulator, connect the sound level calibrator tightly to the artificial ear using the short steel adapter and switch the calibrator on.**
- **Select "Calibration → Artificial ear → HATS Type 3.4" from the main menu.**

For Head Acoustics HMS II, calibrator B&K 4231 must be used in conjunction with the short steel calibration adapter.

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the voltage measured is below 3 mV or fluctuating by more than 0.2 dB, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the test be repeated. After switching on the microphone power supply, wait approx. 20 s before restarting the calibration.

The measured reference value is stored in a file on the hard disk and used for all subsequent measurements when the same ear type 3.4 is used as currently selected.

Reading the DRP-ERP Correction Data of the Artificial Ear of Type 3.4:

Call the routine “Calibration → DRP to ERP Correction → Type 3.4 → From ITU-T P.57 Table 2b”. This procedure needs only be repeated when the “3GPP” directory has been renamed or removed.

Alternatively it is also possible to load individual DRP-ERP correction data from a calibration disk. This option is not conformant with the standards.

Reading the Diffuse Field Equalization Data of the Artificial Ear of Type 3.4:

From Release 10 of 3GPP TS 26.132, diffuse field equalization is applied to receiving frequency response results with handset and headset UEs. Call the routine “Calibration → Diffuse field equalization → Type 3.4 → From ITU-T P.58 Table 3”. This procedure needs only be repeated when the “3GPP” directory has been renamed or removed.

Alternatively it is also possible to load individual diffuse field equalization data from a calibration disk. This option is not conformant with the standards.

Calibration of Artificial Mouth for Handset Tests

Before a mobile phone can be tested, the absolute sensitivity and frequency response of the artificial mouth have to be measured and corrected with the aid of a previously calibrated free-field or diffuse-field (pressure-field) microphone. The measuring microphone removed from artificial ear type 1 can be used for this purpose or an additional microphone capsule is screwed to the microphone preamplifier. The standard microphone is used as a reference for determining the frequency response of the mouth. The frequency response of the microphone can be ignored in the test frequency range (100 Hz to 8 kHz) (see also calibration certificate of microphone capsule).

Since interfering sound falsifies the corrections, the artificial mouth must be calibrated in the anechoic and isolated test chamber. In order to reject any noise present in the test chamber, it is recommended to activate item “Selective” in the calibration menu.

First of all, a calibrated measuring microphone has to be selected.

- **Select a reference microphone type with “Calibration → Artificial mouth → Select reference mic”.**

  For the selected microphone type, a device must be selected and calibrated (see above). This device must be connected to R&S UPV analyzer input 1 via power supply/conditioning amplifier.

  For calibration of a P.51 type artificial mouth using a diffuse field type microphone (e.g. B&K 4131 or 4134) or a microphone from a Type1 artificial ear, fit the microphone at right angles to the mouth at the mouth reference point (MRP) using the gauge supplied with the mouth (positioning at right angles is necessary because diffuse field or pressure-calibrated microphones have a flat frequency response to sound from random incident direction and therefore exhibit an emphasis on high frequencies with frontal sound incidence).

  For calibration of a P.51 type artificial mouth using a free field microphone, the microphone must be mounted in the axis of the sound outlet of the artificial mouth.

For calibration of the HATS (P.58 type) artificial mouth, a ¼" microphone is clamped in the fixture attached to the HATS.

- **Call the calibration routine with "Calibration → Artificial mouth → LRGP ITU-T P.51 → Without Reference Spectrum", "Calibration → Artificial mouth → LRGP ITU-T P.51 → with P.50 Ref. Spectrum", "Calibration → Artificial mouth → HATS ITU-T P.58 → Without Reference Spectrum" or "Calibration → Artificial mouth → HATS ITU-T P.58 → with P.50 Ref. Spectrum" from the main menu.**

The sound pressure generated at the MRP is set to exactly -4.7 dBPa in an automatic measurement routine at 1 kHz. The generator voltage required is stored in a file on the hard disk and used as a reference for all subsequent settings with the same artificial mouth. If the sound pressure cannot be adjusted to -4.7 dBPa, an error message is displayed with a request to check the connection of the artificial mouth and to repeat the measurement. A possible error source would be that the transformer supplied is not connected between the generator and the artificial mouth.

The uncorrected frequency response of the artificial mouth is measured and displayed. Next, the frequency response is measured with the inverse frequency response correction automatically selected in the generator (equalization). Residual errors caused by nonlinearities of the speaker in the mouth are measured and taken into account in the final equalization file as fine correction.

To verify the results, the absolute sound pressure versus frequency is measured at a sound pressure of 4.7 dBPa (reference value for most of the measurements). The absolute sound pressure at each frequency must be within a tolerance band of ±0.2 dB. Correct calibration without interfering sound yields an almost straight line in the middle between the two limit lines.

If mouth calibration with reference spectrum measurement is chosen, the test signal is subsequently filtered with the inverse mouth frequency response, and the resulting spectrum at the MRP is recorded as reference for sending frequency response tests.

If a mouth calibration is performed without reference spectrum measurement, previously recorded reference spectra are invalidated. A sensing measurement using artificial voice according to ITU-T P.50 can only performed after an additional reference spectrum calibration (see below).

P.50 Speech Spectrum Calibration

For tests using artificial voice according to ITU-T P.50 as test signal, the spectrum of the test signal has to be measured and stored as reference spectrum for the transfer function (gain) calculation. For sending and sidetone tests, the signal has to be filtered in addition with the inverse frequency response of the artificial mouth. A calibrated reference microphone must be placed at the Mouth Reference Point (MRP) for this purpose. It is recommended to perform the reference spectrum calibration directly after the mouth calibration, using sub-menu item "Calibration→ Artificial Mouth → … → With P.50 Ref. Spectrum".

The reference spectrum calibration for the receiving direction does not require external equipment or wiring. The reference signal at the output from the R&S UPV generator to the speech input of the system simulator is measured via internal connection to the R&S UPV analyzer

input. For narrow-band tests in receiving direction, a band-limited version of the test signal is used. Each version of the test signal has to be calibrated separately.

For ambient noise rejection according to Release 10 of 3GPP TS 26.132, a separate speech reference spectrum calibration is necessary because the active speech level at the MRP is specified to be +1.3 dBPa instead of -4.7 dBPa for this test. The test routines can be found in sub-menu “Calibration __> P.50 Speech Ref. Spectrum → Sending for ANR”.

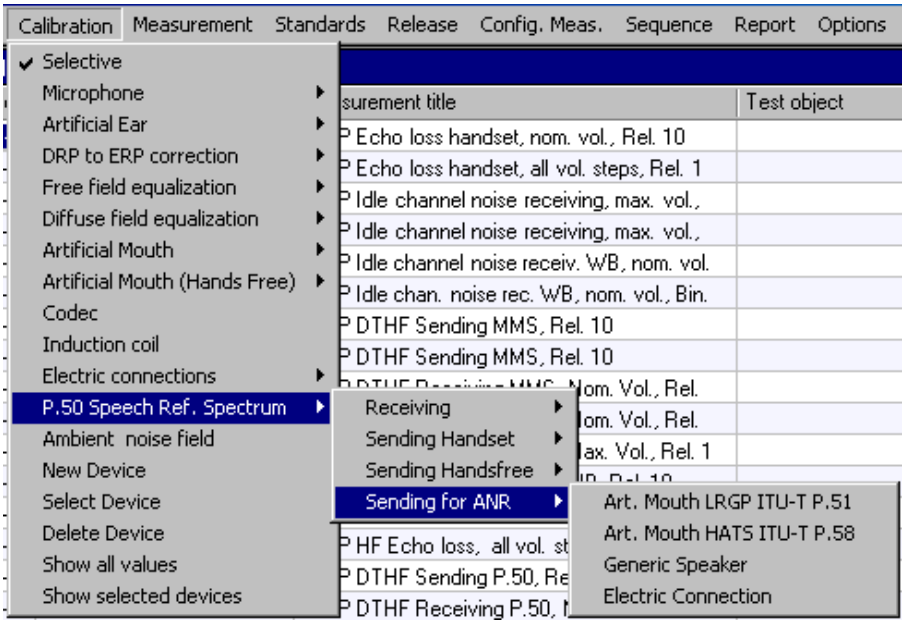


Fig. 43 Submenu for reference speech spectrum calibration

Calibration of CMU Speech Codec

The calibration of the CMU speech coder and decoder is necessary to be able to calculate absolute loudness. Calibration has to be performed only once and must be repeated only if the R&S CMU200 used is replaced. If the R&S CMU200 is equipped with model 14 of the Link Handler R&S CMU-B21, GSM as well as WCDMA use the same paths. Calibration of the coder is therefore identical for both operating modes and need not be repeated when switching from GSM to WCDMA or vice versa.

If GSM and WCDMA use different link handlers, separate calibration devices have to be generated for the two link handlers (i.e. with and without the supplied adapter).

Note that encoder and decoder are handled as separate devices but calibrated with one routine.

Auxiliary settings required for calibration can be found in the R&S CMU200 under Bit Stream (for GSM) and under BS Signal, Dedicated Channel, Voice settings (for WCDMA) (firmware version 4.52 or higher). Call the calibration routines with “Calibration → Codec → CMU/CBT” from the main menu.

The following information is displayed:

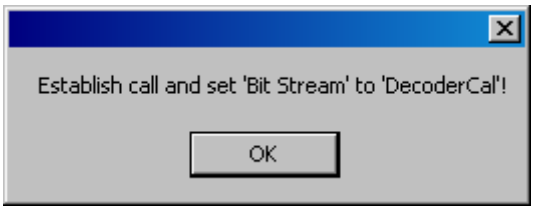


Fig. 44 Message box during decoder calibration

Set up a call to the mobile phone. Set bit stream or voice setting on the R&S CMU200 to "Decoder Cal" and then click the “OK” button.

The actual voltage at the decoder output of the R&S CMU200 is now measured for a digital full-scale signal and the required correction value is calculated and saved in the R&S UPV. The following request is then displayed:

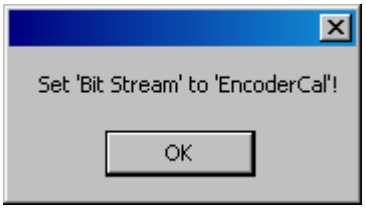


Fig. 45 Message box during encoder calibration

After the “OK” button has been clicked, the input sensitivity of the speech coder is measured and the input voltage required for digital full scale is measured at the speech coder and saved in the R&S UPV.

Calibration of CMW Speech Codec

The CMW500 does not provide the “Decoder Cal” and “Encoder Cal” functionalities. Instead the maximum peak input and output voltage can be set in the user interface.

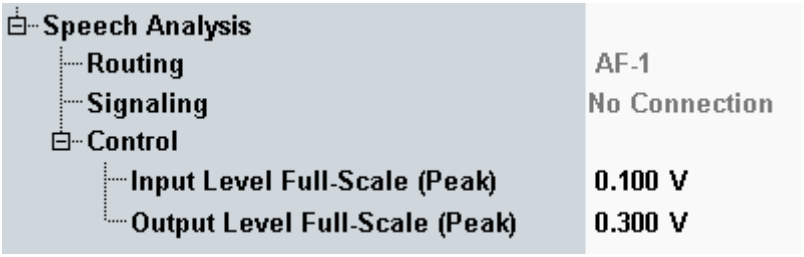


Fig. 46 Setting of the full-scale peak input and output values in the CMW user interface

“Calibration → Codec → CMW” opens windows where these values can be entered in unit mV in the mobile phone test program.

Calibration of Ambient Noise Field

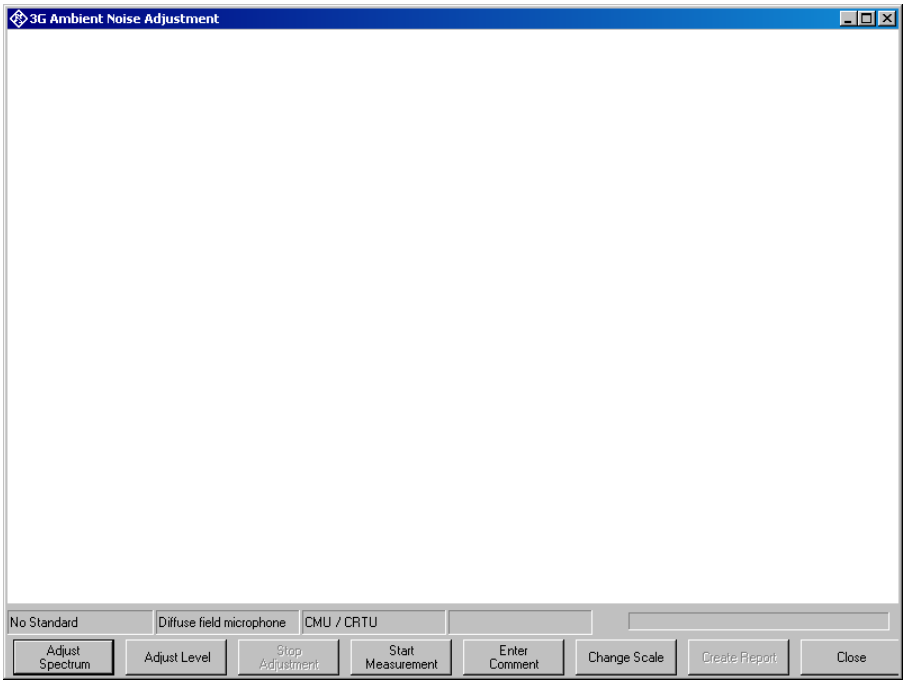


Fig. 47 Measurement window for ambient noise field calibration.

Please refer to application note 1GA51, available on the R&S download web site, for suggestions how to generate the noise field for the ambient noise rejection test. For the calibration of the noise field for ambient noise rejection tests, all obstacles (test head or HATS, Telephone etc.) have to be removed from the test chamber. For the generation of the noise field, additional equipment is necessary. The noise field should have sufficient homogeneity (sound pressure level independent of place) and diffuseness (randomly incident sound at the place of the microphone). This can either be achieved in a reverberation room with omni-directionally radiating sound source or in an anechoic room with a number of uncorrelated noise sources. Limited homogeneity can be achieved in the centre between two speakers. For good diffuseness a minimum of four speakers distributed in different spatial directions are required.

A diffuse field or pressure field microphone must be positioned at the spot of the mouth reference point of the (removed) test head or HATS.

The menu Item Calibration → Ambient noise field opens the window shown in Fig. 26.

The button “Adjust Spectrum” starts a continuous spectrum measurement which allows to adjust the spectrum of the noise, e.g. using equalizers. The template is centred around the curve irrespective of the absolute level.

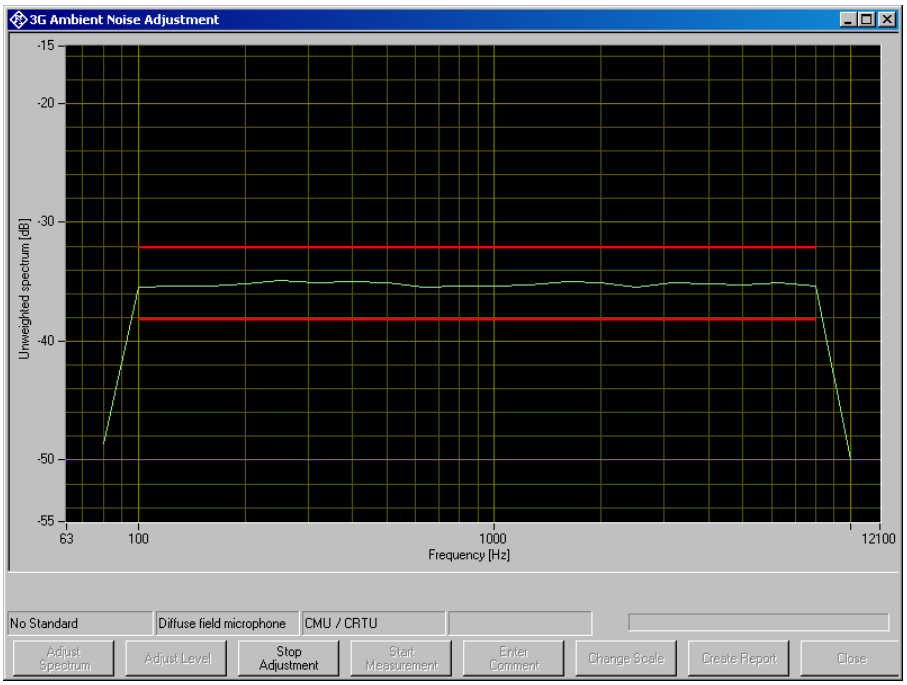


Fig. 48 Measurement window for spectrum adjustment.

The continuous spectrum measurement can be aborted by clicking “Stop Adjustment”.

The button “Adjust level” starts a continuous level measurement. If a multitude of sources is used, each source must produce a sound pressure level of -24 dBPa – 3 * LOG n dB, whereby n is the number of noise sources.

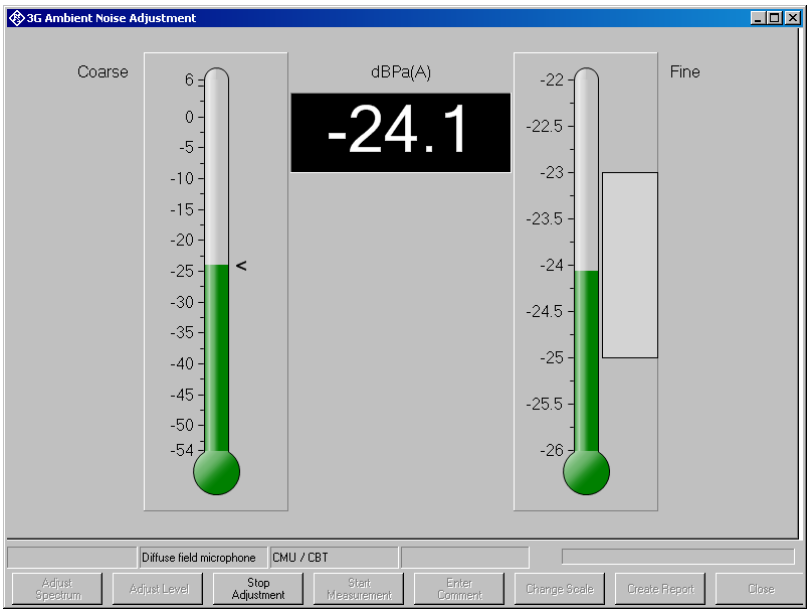


Fig. 49 Measurement window for level adjustment.

The left thermometer column gives a coarse overview. The right column has an enlarged scale for fine adjustment. The numeric field in the centre shows the numeric value.

The continuous level measurement can be aborted by clicking “Stop Adjustment”.

Once the noise field has been adjusted, the result can be documented by pressing “Start Measurement”. Although there is no calibration value to be used in the ambient noise rejection measurement, the level is stored and can be included for reference in the measurement report.

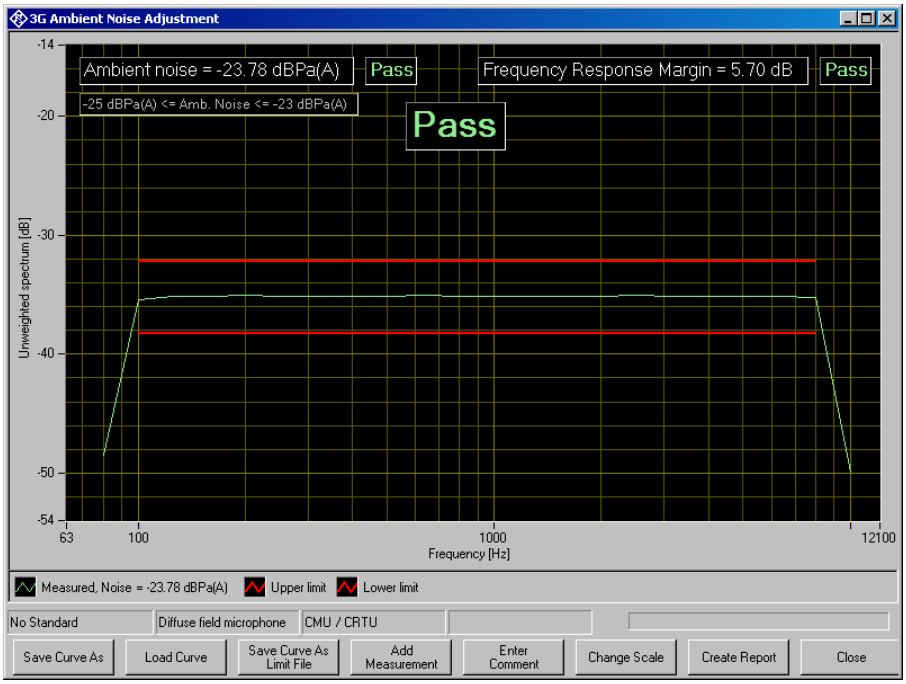


Fig. 50 Result of ambient noise calibration.

Calibration of Noise Field for “Speech Quality in Presence of Background Noise” Test

Connections

Fig. 51 Setup for background noise calibration.

Connect

1. LAN socket of UPV to LAN socket of UPP
2. UPP trigger output to UPV trigger input

3. UPP-Z8A output 3 to input of front left active speaker
4. UPP-Z8A output 4 to input of rear left active speaker
5. UPP-Z8A output 5 to input of front right active speaker
6. UPP-Z8A output 6 to input of rear right active speaker
7. UPP-Z8A configured subwoofer output (by default 7) to input of active subwoofer
8. Right artificial ear to UPV analyzer input 1 via microphone power supply
9. Left artificial ear to UPV analyzer input 2 via microphone power supply

For the delay measurements, a connection has to be made from UPP-Z8A output 10 to UPV input 1, and both artificial ears have to be connected subsequently to UPV analyzer input 2.

Establishing the remote control connection between UPV and UPP

After power up of both instruments and the interconnection with a LAN switch cable, first an IP connection has to be established between UPV and UPP.

1. Start the UPV-K9x program and open window “Options → UPP remote control”.
2. Once the “LAN” LED on the UPP is on, press button “CASCADE / LAN RESET” once and wait until the “CASCADE” LED is blinking.
3. Press the “CASCADE / LAN RESET” button again.
4. Click the “Find” button in the UPP remote control window on the UPV.
5. Now the computer name on the UPP appears in the UPP remote control window. Select it and close the window with “Ok”.

Prerequisites

The calibration of both artificial ears of the HATS is required for performing the calibration of the background noise field.

Configuration

The configuration of the noise field calibration comprises

1. Choice of the calibration method
2. Speaker configuration
3. Bandwidth and tolerance settings
4. Other settings

and is done in the “Noise Calibration Configuration “ window. This window is called with item “Noise calibration configuration” in the “Options” menu.

The configuration is saved in the settings of the UPV-K9x program, so that it has to be done at least once and can then be re-used as long as the speaker configuration and calibration methods do not need to be changed.

Starting and stopping the calibration process

Calibration is started by selecting the following:

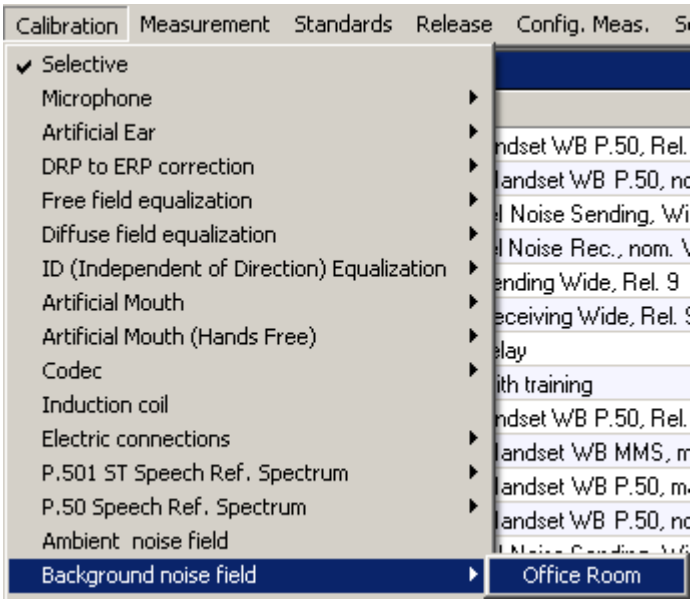


Fig. 52 Starting the background noise calibration process.

A brief set of cabling instructions appears first of all:

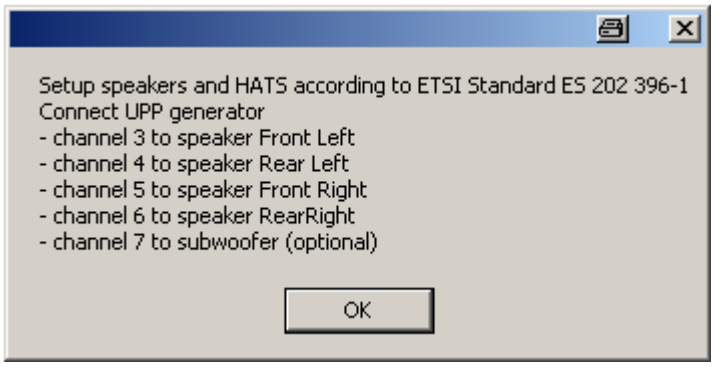

Setup speakers and HATS according to ETSI Standard ES 202 396-1
Connect UPP generator
- channel 3 to speaker Front Left
- channel 4 to speaker Rear Left
- channel 5 to speaker Front Right
- channel 6 to speaker RearRight
- channel 7 to subwoofer (optional)
OK

Fig. 53 Cabling instructions for the speakers.

The measurements then begin. The calibration process can be stopped at any time. All of the calibration data recorded up to this point are then available and can be viewed in the report.

Measurement is stopped in the following way:

- If a dialog box appears, click the "Abort" or "Cancel" button

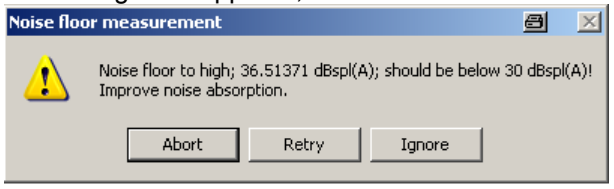


Fig. 54 Setup for background noise calibration.

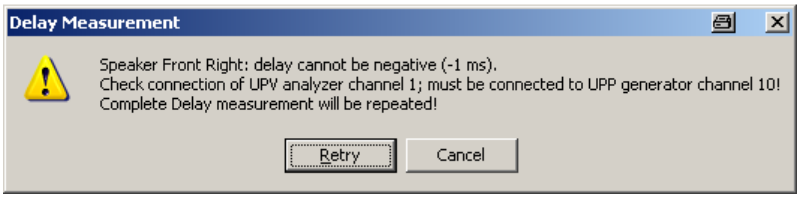

Delay Measurement
Speaker Front Right: delay cannot be negative (-1 ms).
Check connection of UPV analyzer channel 1; must be connected to UPP generator channel 10!
Complete Delay measurement will be repeated!
Retry
Cancel

Fig. 55 Setup for background noise calibration.

- If measurement is still being performed, click the "Cancel" button

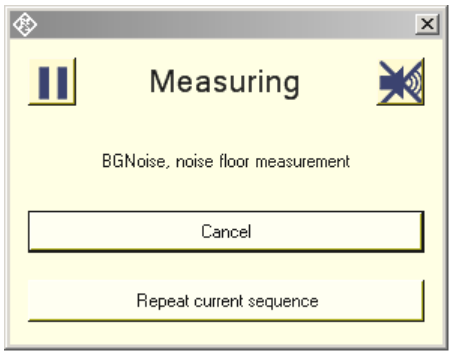


Fig. 56 Window during running measurement.

Preparatory Measurements for Delay Measurement

Before the delay measurement is performed, additional plausibility checks are carried out at each speaker to ensure that the wiring is correct and that the sound pressure level is high enough:

Measurement of Sound Pressure

The unweighted sound pressure level should reach at least 80 dBspl at normal drive level.

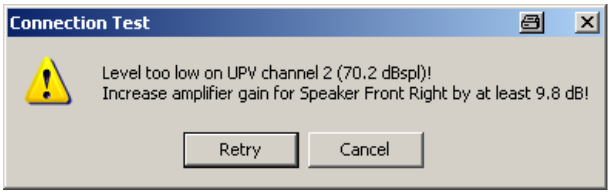

Connection Test
Level too low on UPV channel 2 (70.2 dBspl)!
Increase amplifier gain for Speaker Front Right by at least 9.8 dB!
Retry
Cancel

Fig. 57 Message for insufficient level.

If this sound pressure is not reached, an error message appears which cannot be ignored. After the gain factor has been increased, the measurement can be repeated.

Measurement of Level Change at Microphone Amplifier Output

In the case of an increase in UPP output level and the expected change in sound pressure at the connected speakers, the level measured at the microphone amplifier must be changed by the same amount.

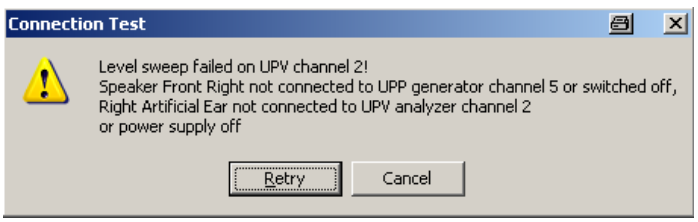

Connection Test
Level sweep failed on UPV channel 2!
Speaker Front Right not connected to UPP generator channel 5 or switched off,
Right Artificial Ear not connected to UPV analyzer channel 2
or power supply off
Retry
Cancel

Fig. 58 Message for insufficient sound pressure level increase.

If the amplifier output does not change with the UPP output level, this may have the following causes:

- the microphone amplifier is switched off
- the HATS ear is not connected to the correct amplifier channel
- the amplifier is not connected or is incorrectly connected to UPV channel 2
- the speaker concerned is switched off
- the speaker concerned is not connected to the correct UPP channel

After the error has been rectified, the measurement can be repeated.

Measurement of Level Change at Reference Input

When the UPP output level is increased, the level at UPV measurement channel 1 connected to UPP generator channel 10 must change by the same amount.

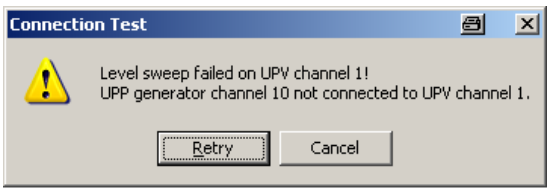

Connection Test
Level sweep failed on UPV channel 1!
UPP generator channel 10 not connected to UPV channel 1.
Retry
Cancel

Fig. 59 Message for insufficient level change at reference input.

If the reference input does not change with the UPP output level, there is no connection between UPV channel 1 and UPP output channel 10.

After the error has been rectified, the measurement can be repeated.

Delay Measurement

The delay measurement determines the time it takes for the sound to travel from the speaker membranes to the left and right ear of the HATS. The travel time and therefore the distance of the full-range speakers from the HATS is measured by means of cross-correlation of the acoustic (sound pressure) signal and the electrical reference signal.

Since the delay measurement is quite complicated owing to the required cabling modifications, it can be skipped if a valid calibration data set is already available and if the speaker layout and the HATS position has not been changed in the meantime. The latter is not decisive for the program; it is therefore the responsibility of the user to repeat the delay calibration where necessary.

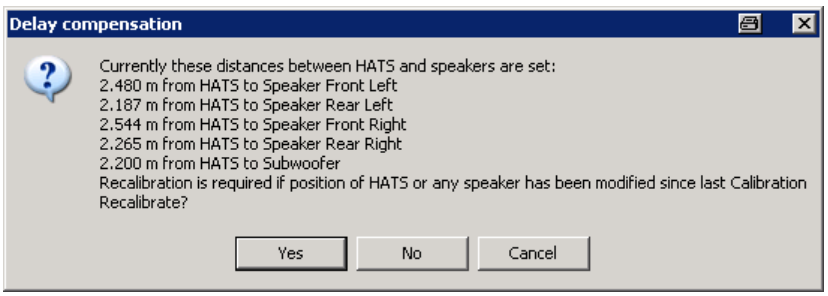

Delay compensation
Currently these distances between HATS and speakers are set:
2.480 m from HATS to Speaker Front Left
2.187 m from HATS to Speaker Rear Left
2.544 m from HATS to Speaker Front Right
2.265 m from HATS to Speaker Rear Right
2.200 m from HATS to Subwoofer
Recalibration is required if position of HATS or any speaker has been modified since last Calibration
Recalibrate?
Yes
No
Cancel

Fig. 60 Message querying the start of the delay calibration.

To perform the delay measurement, the reference signal from channel 10 of the UPP generator is connected to analyzer channel 1 of the UPV, and the signal from the respective ear is connected to analyzer channel 2 (via a preamplifier). Which ear is currently being measured and must therefore be connected is shown in dialog boxes.

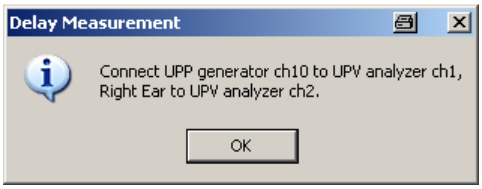


Fig. 61 Instruction for connections during delay measurement.

This box must be confirmed after reconnection of the UPV analyzer; only then are the measurement and the generator signal started. The signal used as the generator signal is always the signal which is also used for subsequent equalization.

Other cabling problems can be determined from the measured value obtained during the delay measurement:

- Checking of the delay differences between the measurement channel and reference channel

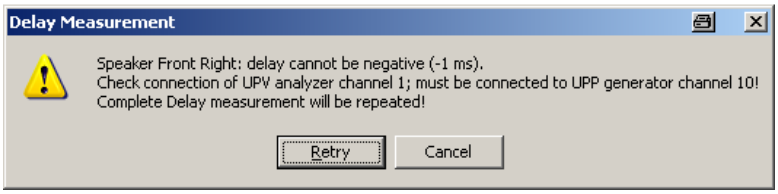

Delay Measurement
Speaker Front Right: delay cannot be negative (-1 ms).
Check connection of UPV analyzer channel 1; must be connected to UPP generator channel 10!
Complete Delay measurement will be repeated!
Retry
Cancel

Fig. 62 Plausibility check for the delay result.

If the reference channel has a greater delay than the measurement channel, it is not connected to the reference signal but instead to the 2nd channel of the microphone amplifier.

- Distance between the speaker and associated HATS ear is too great

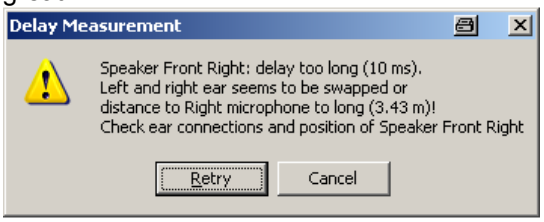

Delay Measurement
Speaker Front Right: delay too long (10 ms).
Left and right ear seems to be swapped or
distance to Right microphone to long (3.43 m)!
Check ear connections and position of Speaker Front Right
Retry
Cancel

Fig. 63 Message for unexpectedly long delay.

If the measured distance is greater than the intended maximum distance, the longer indirect sound path to the ear located opposite may possibly have been measured. In this way it is possible to detect inadvertent swapping of the HATS ears.

- Distance between the speaker and associated HATS ear is too small

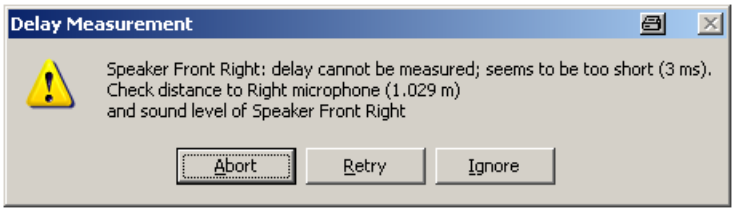

Delay Measurement
Speaker Front Right: delay cannot be measured; seems to be too short (3 ms).
Check distance to Right microphone (1.029 m)
and sound level of Speaker Front Right
Abort
Retry
Ignore

Fig. 64 Message for unexpectedly short delay.

If the distance is less than the intended minimum distance, the speaker is too close to the HATS. This warning can be ignored, if the measured distance matches the actual position of the speaker.

The measurement can be repeated after the cabling and the amplifier level have been corrected.

The cabling must be changed during and after the delay measurement; the user is instructed to do this in dialog boxes.

Connection Test
Ensure Right Ear is connected to UPV analyzer ch1,
Left Ear is connected to UPV analyzer ch2,
and UPP TRG Out is connected to UPV TRG IN!
OK

Fig. 65 Instructions for change of cabling during the calibration process.

After completion of the delay measurement, it is thus ensured that the HATS ears are correctly cabled and the output level is high enough. A list showing all of the determined distances is displayed before the actual equalization begins.

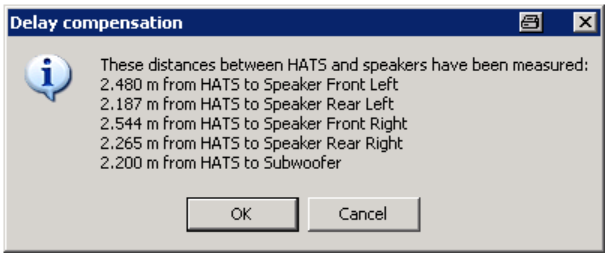

Delay compensation
These distances between HATS and speakers have been measured:
2.480 m from HATS to Speaker Front Left
2.187 m from HATS to Speaker Rear Left
2.544 m from HATS to Speaker Front Right
2.265 m from HATS to Speaker Rear Right
2.200 m from HATS to Subwoofer
OK
Cancel

Fig. 66 List of determined distances.

The minimum and maximum distance between the HATS ear and the speaker can be entered in the configuration dialog box.

Preparatory Measurements for Equalization

Equalization can only be performed successfully if the room acoustics meet certain requirements.

Noise Floor

The permissible noise floor is max. 30 dB(A)spl. If it is above this value, equalization may be incorrect in the case of weak noise fields.

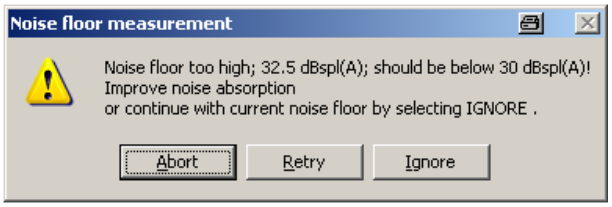

Noise floor measurement
Noise floor too high; 32.5 dBspl(A); should be below 30 dBspl(A)!
Improve noise absorption
or continue with current noise floor by selecting IGNORE .
Abort
Retry
Ignore

Fig. 67 Warning for exceeded noise floor limit.

After the soundproofing has been improved, the measurement can be repeated. "Ignore" continues the calibration process although this limit has been exceeded.

Frequency Response

The permissible frequency response of a speaker before equalization is max. ±9 dB. If it is above this value, equalization is not possible for the room and the room properties and the speaker layout should be improved before equalization is performed.

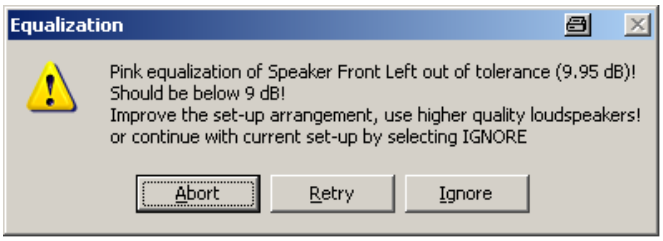

Equalization
Pink equalization of Speaker Front Left out of tolerance (9.95 dB)!
Should be below 9 dB!
Improve the set-up arrangement, use higher quality loudspeakers!
or continue with current set-up by selecting IGNORE
Abort
Retry
Ignore

Fig. 68 Warning for excessive equalization needs.

"Ignore" continues the calibration process although this limit has been exceeded.

Initial rough equalization of the individual speakers is performed during the frequency response check.

Total Harmonic Distortion

Measurement of the total harmonic distortion for each speaker at nominal level in order to prevent speakers from being overdriven. Since destructive interference of the fundamental can occur at discrete frequencies which then results in a poorer total harmonic distortion being determined, the measurement is repeated twice at different frequencies in the case of an error.

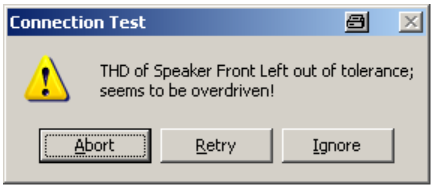


Fig. 69 Warning for excessive total harmonic distortion of a speaker.

If speakers with a high total harmonic distortion are used, the tolerance limit must be set higher in the configuration dialog box.

Cabling Check

This measurement which was already performed during the delay measurement is intended to ensure that the cabling is correct if the delay measurement is skipped and after the cabling has been changed. The results are the same as those under "Measurement of Level Change at Microphone Amplifier Output".

Equalization and Level Adjustment

At the beginning of equalization, a check is performed to establish whether a valid calibration data set is available for the used noise field. If this is the case, equalization of this noise field can be skipped.

Here the Cancel button does not stop the complete calibration procedure but only that of the current (and displayed) noise field.

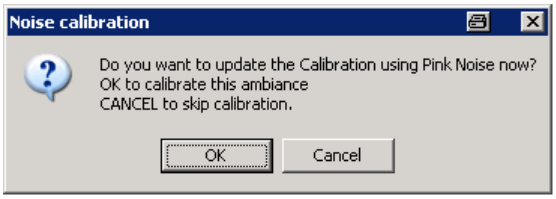

Noise calibration
Do you want to update the Calibration using Pink Noise now?
OK to calibrate this ambiance
CANCEL to skip calibration.
OK
Cancel

Fig. 70 Query window for each noise field calibration.

By skipping all noise fields, all of the noise fields with the current acoustics are checked without changing the calibration data set and a corresponding report is generated.

Equalization and level adjustment are largely performed without input from the user. The only time input is required is if errors occur and the

user is asked what should happen next. These decisions can be preset in the configuration dialog box so that equalization can then be carried out unsupervised without any input from the user.

Level Adjustment

Level adjustment is performed with a maximum of five iteration steps. Normally two steps are sufficient to achieve the desired level tolerance (≥ 0.1 dB, can be set in the configuration dialog box). This number may not be sufficient for the subwoofer, especially in the case of sounds with weak bass. A message is then displayed where the user can choose whether to accept the specified level deviation or to perform a further iteration. This dialog box can be suppressed by activating the following option in the noise calibration configuration window:

Fig. 71 Checkbox for suppressing the message caused by excessive single level deviation.

Equalization

Equalization is performed in two steps:

- Individual equalization of each speaker
- Pairwise equalization of the two left and the two right speakers

Each of the two steps is performed with a maximum number of iteration steps which is selected in the configuration dialog box; three iterations are usually enough to achieve a flatness of 1 dB.

If the all speaker equalization check does not result in a PASS, the user can try to achieve a PASS by repeating this measurement. This may be successful if, for example, the tolerance violation is only slight or unwanted noise falsified the measurement.

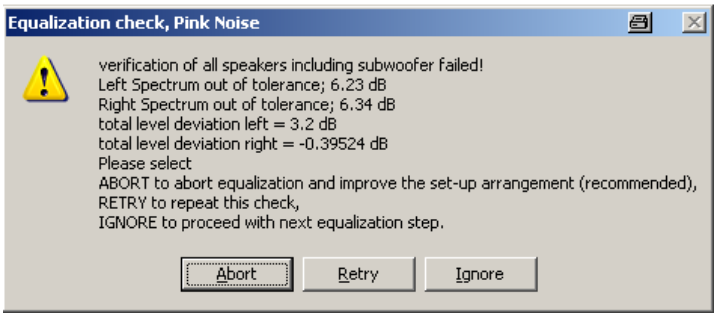

Equalization check, Pink Noise
verification of all speakers including subwoofer failed!
Left Spectrum out of tolerance; 6.23 dB
Right Spectrum out of tolerance; 6.34 dB
total level deviation left = 3.2 dB
total level deviation right = -0.39524 dB
Please select
ABORT to abort equalization and improve the set-up arrangement (recommended),
RETRY to repeat this check,
IGNORE to proceed with next equalization step.
Abort
Retry
Ignore

Fig. 72 Message for failed verification of all speaker equalizations.

The associated dialog box can be suppressed by selecting the appropriate entry in the configuration dialog box.

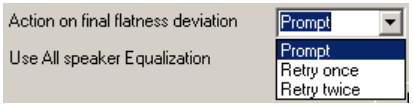


Fig. 73 Selection of action on failed verification of all speaker equalizations in the noise calibration configuration window.

Instead of "Prompt", the user can determine whether one or two retries are to be performed automatically and then FAIL is to be set as the result if the last retry was also unsuccessful.

The result of each intermediate step is displayed as a trace during equalization.

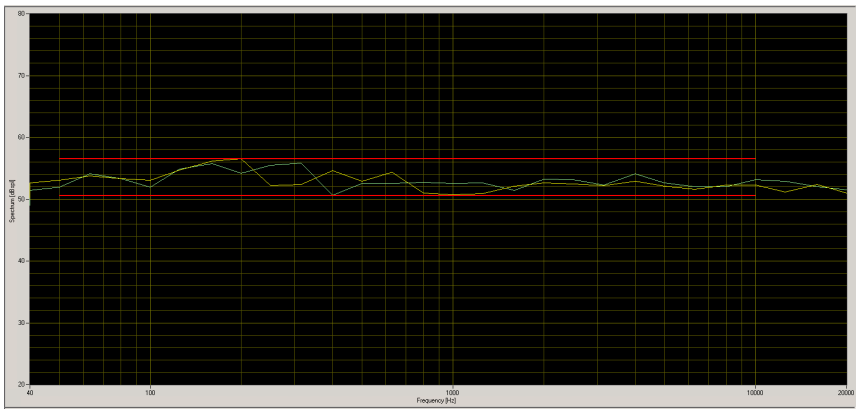


Fig. 74 Display of intermediate equalization results.

All Speaker Equalization

Following an unsuccessful all speaker equalization check, it is possible to adjust the all speaker equalization to within the ±3 dB tolerance band by subsequent correction of individual speakers. Since this algorithm is extremely time-consuming and not always successful, it can be deactivated in the configuration dialog box.

Fig. 75 Checkbox in the noise calibration configuration window for deactivating the additional all speaker equalization step.

If "All Speaker Equalization" is activated, further equalization steps are performed:

- Measurement of the crosstalk flatness separately for left and right. If at least one of these is outside the tolerance, the crosstalk speaker which impairs the frequency response most is determined (by switching off the other crosstalk speaker). Starting with this speaker, the four crosstalk speakers are equalized again individually (next is the other speaker on the same side followed by the next worse speaker) until the interaction of all speakers is below the tolerance limit or repeated equalization of all four speakers was unsuccessful.
- If this equalization step was unsuccessful, adjustment with the direct speakers is attempted. Once again the direct speaker which impairs the frequency response most is determined. Starting with this speaker, the four direct speakers are equalized again individually until the interaction of all speakers is below the tolerance limit or repeated equalization of all four speakers was unsuccessful.

If this equalization step is also unsuccessful, equalization has definitively failed and must be repeated with improved room properties.

4 Data Entry for Reporting

Operator

Under “Data→Operator” an operator’s name can be entered which is stored in association with all calibration and measurement results. If “Operator” is activated in the report settings, the name will appear in all reports about these measurements.

Test object

Under “Data → Test object → New” a description of the device under test can be entered.

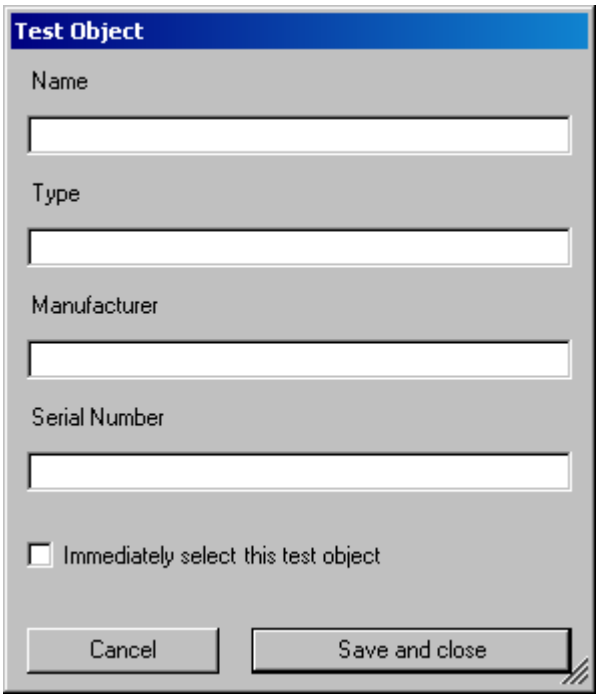


Fig. 76 Window for input of information about a test object

If the checkbox “Immediately select this test object” is checked, the test object associated with the entered data is automatically selected upon closing the window. The data of this selected test object will be stored in association with all measurements and appear on the associated reports if “DUT information” is activated in the report settings.

A previously entered test object can be selected with “Data → Test object → Select”.

5 Measurements

General

Special problems caused by the coding and decoding algorithms of mobile phones are encountered when measuring acoustic characteristics. Voice codecs are used to attain the lowest possible data rate. Mobile phone voice codecs are optimized for transmitting human speech with low data rate. Not the actual voice signals but only the filter and fundamental parameters required for signal reconstruction are transmitted.

Purely sinusoidal tones normally used for audio measurements cannot be transmitted with such a system. Therefore, the coder and decoder had initially been excluded from the measurement, which required a specially prepared test mobile phone with a specific test interface.

In modern mobile phones, this interface is not available anymore. Measurements are generally performed via the air interface with the speech coder and decoder included. As mentioned above, measurements using sinusoidal tones cannot be performed because the static sinusoidal input signal becomes a more or less stochastic output signal as a result of coding, particularly in the medium and high audio frequency ranges.

Signals similar to voice therefore have to be used for the measurement, i.e. either artificial voice according to ITU-T P.50 or a multitone signal according to ITU-T P.501 is possible. At the same time, modulation of the signal in time must largely correspond to voice, since many modern mobile phones use algorithms for interference suppression which use the modulation to distinguish the useful from the interfering signal.

The test routines in the R&S UPV-K91 use an amplitude-modulated multitone signal according to ITU-T P.501 as described in 3GPP TS 26.132 or alternatively artificial voice according to ITU-T P.50 (update key UPV-K9101 or UPV-K9102 required).

Starting measurements

Measurements can be started from the “Measurement” menu. This menu contains either all available measurements, or the measurements belonging to the selected standard if the checkbox “Allow only selected measurements” in the “Options → Select standard” window is checked.

The menu “Standards” allows to start any measurement, whereby the measurements are structured into submenus according to the standards to which they belong. This allows a quick and easy access to all available measurements.

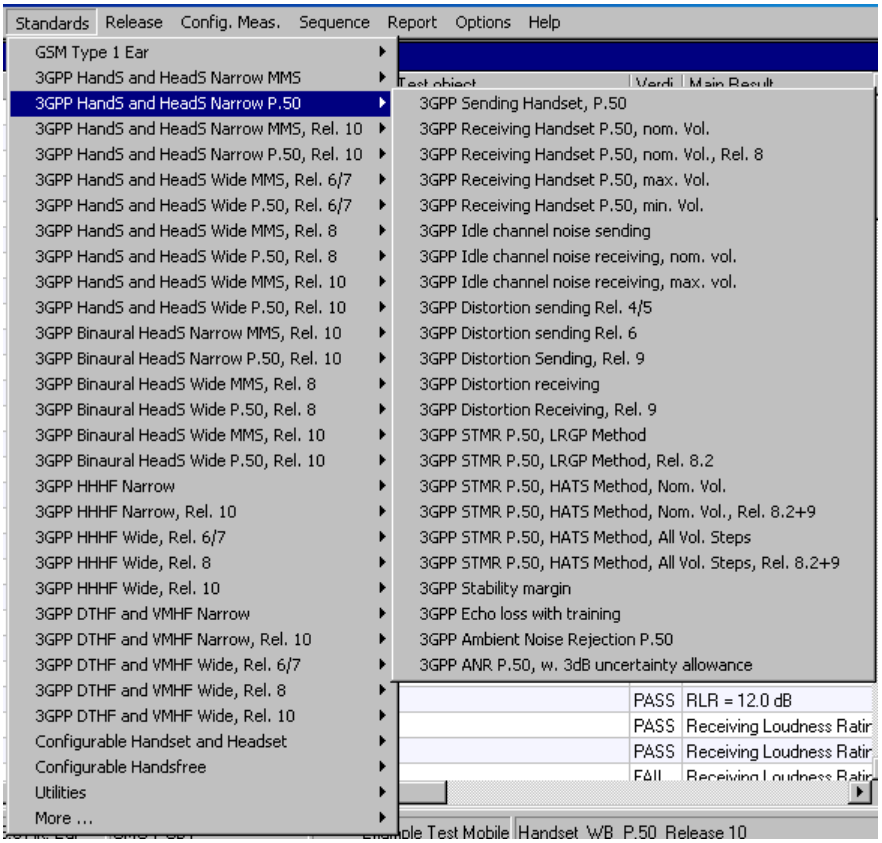

Standards
Release
Config. Meas.
Sequence
Report
Options
Help
GSM Type 1 Ear
3GPP HandS and HeadS Narrow MMS
3GPP HandS and HeadS Narrow P.50
3GPP HandS and HeadS Narrow MMS, Rel. 10
3GPP HandS and HeadS Narrow P.50, Rel. 10
3GPP HandS and HeadS Wide MMS, Rel. 6/7
3GPP HandS and HeadS Wide P.50, Rel. 6/7
3GPP HandS and HeadS Wide MMS, Rel. 8
3GPP HandS and HeadS Wide P.50, Rel. 8
3GPP HandS and HeadS Wide MMS, Rel. 10
3GPP HandS and HeadS Wide P.50, Rel. 10
3GPP Binaural HeadS Narrow MMS, Rel. 10
3GPP Binaural HeadS Narrow P.50, Rel. 10
3GPP Binaural HeadS Wide MMS, Rel. 8
3GPP Binaural HeadS Wide P.50, Rel. 8
3GPP Binaural HeadS Wide MMS, Rel. 10
3GPP Binaural HeadS Wide P.50, Rel. 10
3GPP HHHF Narrow
3GPP HHHF Narrow, Rel. 10
3GPP HHHF Wide, Rel. 6/7
3GPP HHHF Wide, Rel. 8
3GPP HHHF Wide, Rel. 10
3GPP DTHF and VMHF Narrow
3GPP DTHF and VMHF Narrow, Rel. 10
3GPP DTHF and VMHF Wide, Rel. 6/7
3GPP DTHF and VMHF Wide, Rel. 8
3GPP DTHF and VMHF Wide, Rel. 10
Configurable Handset and Headset
Configurable Handsfree
Utilities
More ...
3GPP Sending Handset, P.50
3GPP Receiving Handset P.50, nom. Vol.
3GPP Receiving Handset P.50, nom. Vol., Rel. 8
3GPP Receiving Handset P.50, max. Vol.
3GPP Receiving Handset P.50, min. Vol.
3GPP Idle channel noise sending
3GPP Idle channel noise receiving, nom. vol.
3GPP Idle channel noise receiving, max. vol.
3GPP Distortion sending Rel. 4/5
3GPP Distortion sending Rel. 6
3GPP Distortion Sending, Rel. 9
3GPP Distortion receiving
3GPP Distortion Receiving, Rel. 9
3GPP STMR P.50, LRGP Method
3GPP STMR P.50, LRGP Method, Rel. 8.2
3GPP STMR P.50, HATS Method, Nom. Vol.
3GPP STMR P.50, HATS Method, Nom. Vol., Rel. 8.2+9
3GPP STMR P.50, HATS Method, All Vol. Steps
3GPP STMR P.50, HATS Method, All Vol. Steps, Rel. 8.2+9
3GPP Stability margin
3GPP Echo loss with training
3GPP Ambient Noise Rejection P.50
3GPP ANR P.50, w. 3dB uncertainty allowance
PASS
RLR = 12.0 dB
PASS
Receiving Loudness Ratir
PASS
Receiving Loudness Ratir
Handset WB P.50 Release 10

Fig. 77 “Standards” menu with submenu for narrow band handset tests according to 3GPP TS 26.132, using artificial voice according to ITU-T P.50.

The menu “Release” offers all applicable test cases for a selected combination of UE device type, speech codec bandwidth, test signal and release of the 3GPP test specifications. Item “Select Release” opens the selection window of Fig. 7. Sub-menu “Settings” has the same test case entries and allows to open the editing window of Fig. 66.

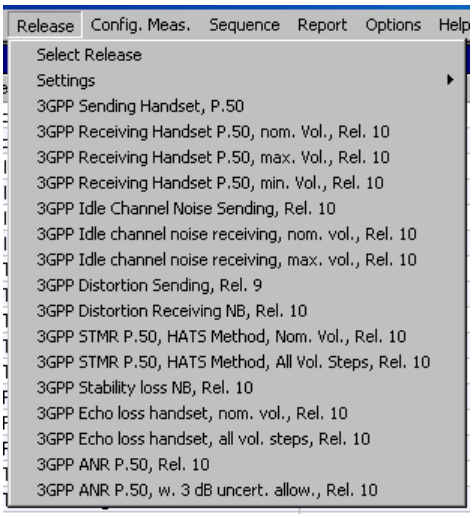

Release
Config. Meas.
Sequence
Report
Options
Help
Select Release
Settings
3GPP Sending Handset, P.50
3GPP Receiving Handset P.50, nom. Vol., Rel. 10
3GPP Receiving Handset P.50, max. Vol., Rel. 10
3GPP Receiving Handset P.50, min. Vol., Rel. 10
3GPP Idle Channel Noise Sending, Rel. 10
3GPP Idle channel noise receiving, nom. vol., Rel. 10
3GPP Idle channel noise receiving, max. vol., Rel. 10
3GPP Distortion Sending, Rel. 9
3GPP Distortion Receiving NB, Rel. 10
3GPP STMR P.50, HATS Method, Nom. Vol., Rel. 10
3GPP STMR P.50, HATS Method, All Vol. Steps, Rel. 10
3GPP Stability loss NB, Rel. 10
3GPP Echo loss handset, nom. vol., Rel. 10
3GPP Echo loss handset, all vol. steps, Rel. 10
3GPP ANR P.50, Rel. 10
3GPP ANR P.50, w. 3 dB uncert. allow., Rel. 10

Fig. 78 “Release” menu

A fourth possibility to start a single measurement is the button “Run highlighted as single measurement” in the sequence menu (see chapter 7 below).

Functionality and control of the measurement macros

Fig. 79 Example of a measurement window

When a measurement macro is started, e.g. from the “Measurement” menu, the standardized measurement is immediately executed. With a single measurement, the window of the measurement macro stays open after the measurement is terminated. At that time, the following functionality is available:

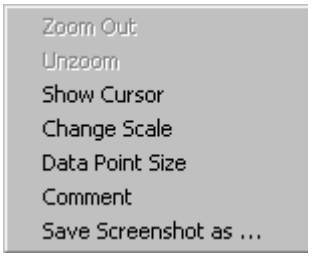


Fig. 80 Context menu of the graph window

Zooming

When the “Shift” key on the keyboard is pressed, the mouse cursor changes to the zoom cursor. When the left mouse button is pressed, a rectangle can be marked in the graph. As soon as the left mouse button is released, the graph is zoomed into the area of the marked rectangle

“Zoom Out” in the graph context menu reverses the last zooming step. “Unzoom” zooms completely out to the original scaling.

Changing the Scale of the Graph

“Change Scale” in the context menu opens a window in which the upper and lower bounds of both axes can be entered by numbers.

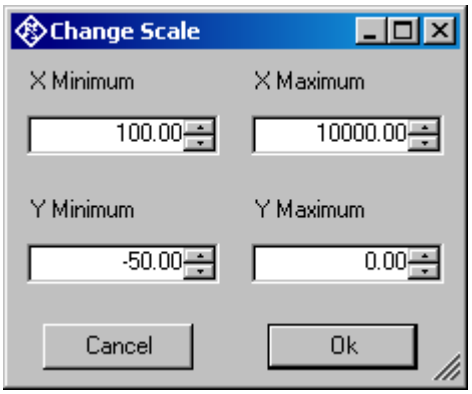


Fig. 81 Window for changing the scale of the graph

Cursor

When the item “Show Cursor” is marked in the graph context menu, a cursor is displayed which can be dragged along the graph with the mouse. X and Y values of the data points below the cursor are displayed.

Data Point Size

“Data Point Size” in the graph context menu opens a window in which the size of marks at the measured data points can be specified. Moving the mouse cursor over one of the marks causes the associated X and Y values to be displayed.

Entering a Comment

With the softkey “Enter Comment” or the item “Comment” in the graph context menu, a comment can be entered and edited which will appear in the report about the respective measurement.

Storing a Hardcopy of the Graph

With the menu item “Save Screenshot as …” in the graph context menu, a hardcopy of the current graph window with all numeric displays, legend etc. can be stored as image. The current view of the graph including additional curves, current scaling and size is copied. However, colours are inverted to a printer-friendly colour set.

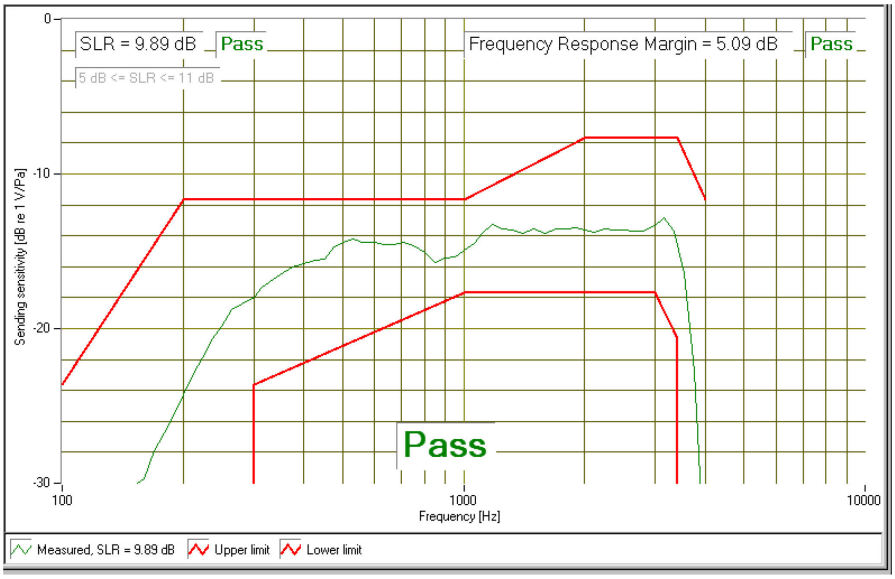


Fig. 82 Hardcopy of measurement graph

Making Additional Measurements

The softkey “Add Measurement” triggers another measurement according to the specification of the test. Loudness ratings and other result values like total noise level are calculated and displayed in the legend. The additional curves and results will appear in the report if item “Store results of further measurements” had been activated before the measurement was started. However, limits are not checked for additional measurements.

This function can e.g. be used to find the correct volume setting to pass nominal RLR. It can further be used for adjustments in the device under test.

Storing and Loading Curves

All curves in the graph can be stored to an ASCII file (*.tra), and such curves can be loaded back into the graph. For easy import to Excel the csv format is also offered. The softkey “Store Curve” opens a window in which a combo box offers choice between the legends of all curves in the graph. The curve associated in which the selected entry is stored to the file with the specified format at the specified location.

If the “Options” menu item “Store loaded curves to results database” is checked, loaded curves are stored together with the measurement results and will appear in reports about the measurement.

Frequency response curves may also be stored as (relative!) UPL-compatible trace files.

Storing Curves as Limit Curves

With “Store As Limit Curve” a curve can be selected and stored into a R&S UPV format limit file with a specified shift in Y axis direction. This functionality can be used to generate limit curves from “golden” devices for evaluation purpose.

Deleting Additional Curves in the Measurement Graph

By pressing or clicking “Delete Curve”, an additional curve in the measurement graph can be removed. A window pops up with a combo box in which the curve to be deleted can be selected. Note that it is not possible to delete the curve of the first measurement, as this is the measurement for which the verdict is given. The selected curve disappears from the graph on the screen and is removed from the database such that it does not appear in reports anymore.

Creating a Report

The softkey “Create Report” causes a report to be prepared. The report preview window (see below) opens and shows the preview of the report. Buttons in the preview window allow to print the report or to export it to PDF, WORD, EXCEL or Rich Text format.

Closing the Measurement Window

The softkey “Close” closes the measurement window. The control is returned to the R&S UPV-K9 main window. All relevant data associated with the measurement is imported to the results data. A new entry appears for the measurement as new row on the bottom of the overview data grid in the main window.

Notes on Handset Measurements

Applicability of Measurements and Equipment Depending on the Release

The 3GPP standard is constantly updated according to technical advances etc. Therefore different versions of the specifications exist in parallel, the so-called releases. Use the “Release” menu to display testcases applicable for a certain release. Furthermore, a separate spreadsheet “TestCaseList_23147.xls” is provided which lists all tests and their applicability for the different releases. This test case list also serves as a reference for the file names used as parameters when starting a test case remotely.

Sending Frequency Response and Loudness Rating

Sending Frequency Response

The sending frequency response is specified as the transmission ratio in dB of the voltage at the decoder output to the input noise pressure at the artificial mouth.

With ear type 3.1 and 3.2 the mobile phone under test is installed in the LRGP (loudness rating guard-ring position) according to ITU-T P.76, and the receiver is sealed to the artificial ear. With ear types 3.3 and 3.4 the mobile phone is mounted on the HATS using the handset positioner. The adjustment angles on the handset positioner are not specified in the standard but should be noted for later reference.

A test signal with a sound pressure of -4.7 dBPa are created with the artificial mouth at the MRP (mouth reference point), and the corresponding output voltage is measured at the R&S CMU200 speech decoder output and evaluated.

The sending frequency response must be within the limit lines specified according to table 1 of 3GPP TS 26.131. The absolute sensitivity is not yet taken into account. The valid limit lines depend on the release of the specification and are different for narrowband and wideband speech.

The offset of the measured frequency response to the upper or lower limit line is calculated and then the whole limit template is shifted to be centered with respect to the measured curve. Then another limit check is performed. If the shifted curve is now within the limit lines, PASS is output, otherwise FAIL is displayed. The limit check is performed at each measured frequency. If the measured value and the end point of a limit line are not at the same frequency, it may happen that the trace slightly crosses a corner of the limit line although there are no limit violations. The remaining margin is displayed. A negative margin shows the amount of limit violation.

Sending Loudness Rating

The sending loudness rating (SLR) takes into account the absolute loudness in the transmit direction and weights the tones in compliance with the average speech spectrum and the normal sensitivity of the average human ear.

To this end, the frequencies (Hz) of bands 4 to 17 (narrowband) or bands 1 to 20 (wideband), resp., are evaluated according to table 1 of ITU-T P.79.

Table 2 Frequencies (Hz) of bands 1 to 20 acc. to table 3 of ITU-T P.79

Band	1	2	3	4	5	6	7
f (Hz)	100	125	160	200	250	315	400

Band	8	9	10	11	12	13	14
f (Hz)	500	630	800	1000	1250	1600	2000

Band	15	16	17	18	19	20
f (Hz)	2500	3150	4000	5000	6300	8000

The sensitivity in dBV/Pa at each frequency is defined as the difference between the level at the network interface (digital level measured at the analog R&S CMU200 speech output) and the sound pressure level at the mouth reference point (MRP), and the sending loudness rating is calculated according to formula 5-1 of ITU-T P.79. The weighting factors are taken from ITU-T P.79, table A2 for narrowband and for wideband according to release 8 and later, and from ITU-T P-79, table G1 for wideband according to release 6 and 7. Note that loudness rating values are loss values, i.e. a high loudness rating values indicates a low gain and a low loudness rating value indicates a high gain.

Due to the input sensitivity tolerance of the R&S CMU200 speech coder, the individual sensitivity of the R&S CMU200 used has to be taken into account in order to calculate the sending loudness rating (see calibration routines). According to 3GPP TS 26.131, the sending loudness rating should be between 5 dB and 11 dB, with lower dB values corresponding to greater loudness (5 dB = maximum loudness, 11 dB = minimum loudness). The measured SLR is indicated in a window in the frequency response display and checked for compliance with these limits. In addition to the numeric value, either PASS or FAIL is displayed.

The general PASS or FAIL information is obtained from the limit check of the frequency response curve and the loudness rating. PASS is output only if both the curve and the loudness value are within tolerances.

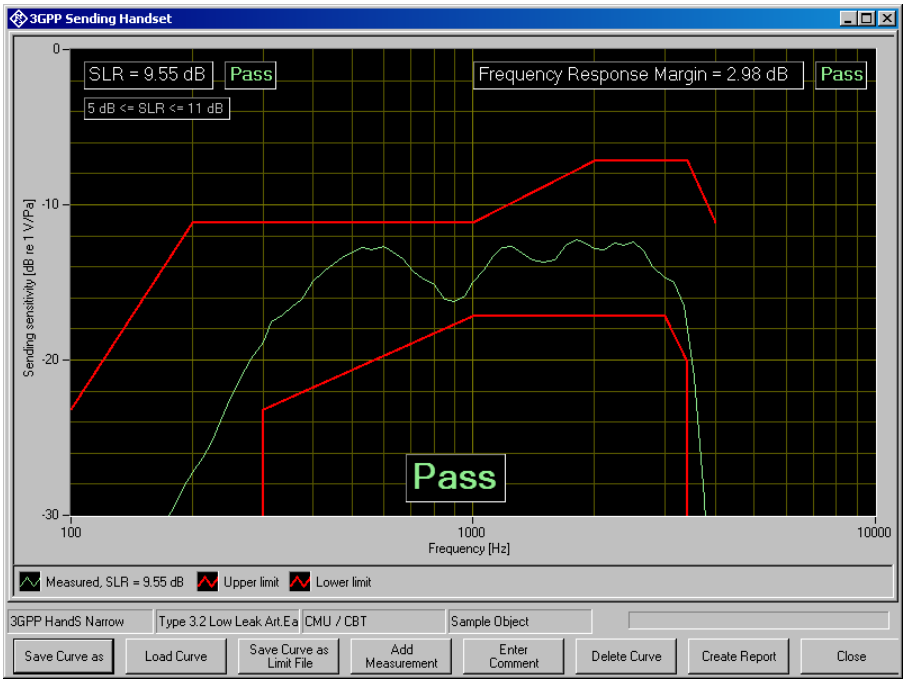


Fig. 83 Sending frequency response with SLR value displayed

Sending Tests using Artificial Voice according to ITU-T P.50 as Test Signal

Modulated multisine as test signal is proven to pass GSM and 3GPP codecs “enhanced full rate” and AMR (adaptive multi-rate) with 12.2 kbit/s without significant degradation. However, most recent background noise reduction algorithms employ more sophisticated indicators than just variation over time to distinguish between voice signals and background noise signals. As a consequence, the spectrum of the modulated multisine signal may be altered by such algorithms, which results in a change in the measured frequency response. For this reason all sending, receiving, sidetone and ambient noise rejection tests are alternatively offered with artificial voice according to ITU-T P.50 as test signal, although background noise reduction is mainly employed in the sending path of mobile phones (update key UPV-K9101, UPV-K9102 or UPV-K9103 required).

The test signal simulates the spectrum and time structure of human voice without having any semantic content. It consists of 10 seconds “female” voice and 10 seconds “male” voice.

Other than with the modulated multisine, the reference spectra at the respective inputs of the transmission path are measured in advance and stored in files. Therefore the speech spectrum calibration for sending direction is a prerequisite for this test (see chapter 3 “Calibration”).

To make sure that the spectral transform is performed on the same portion of the test signal during reference spectrum measurement and output spectrum measurement, the output spectrum measurement is preceded by a delay measurement employing a sine burst. The start of the measurement is then delayed against the playback of the test signal by the measured amount of delay in the transmission path. If the transmission path is interrupted, e.g. due to a dropped call, the test stops with a suitable warning message.

Receiving Frequency Response and Loudness Rating

The following three groups of measurement definitions are available, as the permissible limit values of the loudness rating depend on the volume set in the mobile phone under test: "…, nom. Vol" checks loudness rating limits for nominal loudness setting and at the same time compliance with the frequency response limit template. "…, max. Vol." checks the receiving loudness rating at the highest volume setting against a minimum. "…, min. Vol." checks the receiving loudness rating at the lowest volume setting against a maximum. *(Note: As the loudness rating is a loss value, a high RLR is associated with a soft speech signal and a low RLR is associated with a loud speech signal).*

Receiving Frequency Response

The receiving frequency response is specified as the transmission ratio in dB of the sound pressure in the artificial ear to the rms value at the network interface, applied as input voltage at the speech coder input of the R&S CMU200. The measured sound pressure is either referenced to the ear reference point (ERP) or (from release 10) to DRP with diffuse field correction. For ear type 1, the measuring microphone is directly applied to the ERP and no further correction is required. For ear types 3.x, the measuring microphone is applied to the drum reference point (DRP), which is the reason why any measured value has to be converted to the ERP by means of calibration factors. For special purpose there are separate measurements supplied with R&S UPV-K91 which measure the sound pressure referenced to the DRP.

The mobile phone under test is installed in the LRGP (ITU-T P.76) or on the HATS. In case of ear type 1, the receiver is sealed to knife edge of the artificial ear. In case of ear type 3.2, the receiver is sealed to the rubber gasket of the artificial ear. If the low leak version of this ear type is used, care must be taken that the defined leak opening at the circumference of the artificial ear is not accidentally covered. On the HATS with artificial ear type 3.3, a certain application force, e.g. 8N has to be set on the handset fixture.

The speech coder is driven such that a signal with a system reference level of -16 dBm0 is obtained. The sound pressure in the artificial ear is measured and evaluated.

Ear type 1 will no longer be used for measurements on 3GPP mobile phones. Therefore, 3GPP TS 26.131 defines limit values only for ear types 3.x, whereas the limit values specified in 3GPP TS 51.010 (previously GSM 11.10) are still valid for ear type 1.

Use tests "3GPP GSM Rel. 4 Receiving Handset, nom. Vol", "3GPP GSM Rel. 4 Receiving Handset, max. Vol", "3GPP GSM Rel. 4 Receiving Handset, min. Vol" for receiving tests with type 1 artificial ear. From Release 9 only ear types 3.3 and 3.4 are allowed for standard-conformal tests. From Release 10 only ear type 3.3 is allowed. Frequency response limits have been adjusted accordingly. Use the appropriate versions of the receiving testcase.

When ear type 1 is used, the receiving frequency response must be within the limit lines specified in table 30.2 of 3GPP TS 51.010. When ear type 3.x is used, it must be within the limit lines specified in 3GPP TS 26.131. In the frequency response curve, the limit template is shifted to be centred with respect to the displayed absolute sensitivity.

The margins of the measured frequency response to the upper and lower limit lines are calculated separately, and then the whole template is shifted such that the resulting margins to upper and lower limit are equal. Then another limit check is performed. If the shifted curve is now within the limit lines, PASS is output, otherwise FAIL is displayed. The limit check is performed at each measured frequency. If the measured value and

the end point of a limit line are not at the same frequency, it may happen that the trace slightly crosses a corner of the limit line although there are no limit violations. The remaining margin is displayed. A negative margin shows the amount of limit violation.

Receiving Loudness Rating

The receiving loudness rating (RLR) takes into account the absolute loudness in the receive direction and weights the spectral components in compliance with the difference between an average speech spectrum and the normal threshold of hearing in quiet of the average human ear.

To this end, the frequencies (Hz) of bands 4 to 17 (narrowband) or bands 1 to 20 (wideband), resp., are evaluated according to table 1 of ITU-T P.79 (see table 2)

The sensitivity at each frequency is specified as the ratio dBPa/V, calculated from the level difference between the level at the network interface (measured at the analog R&S CMU200 speech decoder output) and the sound pressure level at the artificial ear, referenced to the ERP, and the receiving loudness rating is calculated according to formula 5-1 of ITU-T P.79. The weighting factors are taken from ITU-T P-79, table A2 for narrowband and for wideband according to release 8, and from ITU-T P-79, table G1 for wideband according to release 6 and 7.

Due to the output gain tolerance of the R&S CMU200 speech decoder, the individual sensitivity of the R&S CMU200 used has to be taken into account in order to calculate the receiving loudness rating (see section “Calibration” above).

The receiving loudness rating depends on the volume setting on the mobile phone under test and, according to 3GPP TS 26.131, should be between -1 dB and +5 dB for narrowband and for wideband according to release 8 and later, and between 2 dB and 8 dB for wideband according to release 6 and 7, obtained at a rated (“nominal”) loudness setting, with lower dB values corresponding to a higher loudness.

The RLR must not fall below -13 dB (-10 dB for wideband in release 6 and 7) when maximum loudness is set on the mobile phone. To prevent damage to the human ear, the maximum receiving loudness must not exceed a certain value.

The measured RLR is indicated in a window in the frequency response display and checked for compliance with these limits. In addition to the numeric value, either PASS or FAIL is displayed.

With “3GPP Receiving Handset, nom. Vol”, the general PASS or FAIL information is obtained from the limit check of the frequency response curve and the loudness rating. PASS is output only if both the curve and the loudness value are within tolerances.

“3GPP Receiving Handset, max. Vol” checks only the RLR against a minimum of -13 dB. The frequency response curve is shown for information only.

“3GPP Receiving Handset, min. Vol” checks the RLR against a maximum of +18 dB.

Fig. 84 Receiving frequency response with RLR value displayed

Receiving Tests using Artificial Voice according to ITU-T P.50 or Single-Talk Speech according to ITU-T P.501 as Test Signal

Receiving tests are alternatively offered with artificial voice according to ITU-T P.50 or Single-Talk Speech according to ITU-T P.501 as test signal (update key UPV-K9101, UPV K9102 or UPV-K9103 required for P.50, update key UPV-K9103 required for P.501).

The P.50 test signal simulates the spectrum and time structure of human voice without having any semantic content or language-specific characteristics. It consists of 10 seconds “female” voice and 10 seconds “male” voice.

The P.501 single-talk test signal contains six sentences recorded with male voices and six sentences recorded with female voices.

Other than with the modulated multisine, the reference spectra at the respective inputs of the transmission path are measured in advance and stored in files. Therefore the respective speech spectrum calibration narrowband or wideband for receiving direction is a prerequisite for this test (see chapter 3 “Calibration”).

To make sure that the spectral transform is performed on the same portion of the test signal during reference spectrum measurement and output spectrum measurement, the output spectrum measurement is preceded by a delay measurement employing a sine burst. The start of the measurement is then delayed against the playback of the test signal by the measured amount of delay in the transmission path. If the transmission path is interrupted, e.g. due to a dropped call, the test stops with a suitable warning message.

Sidetone Masking Rating (STMR)

The sidetone path is the deliberate output of a part of the signal picked up by the microphone to the phone's receiver. This is to create a natural hearing impression for the person speaking on the phone as is encountered under normal conditions involving an acoustic path between mouth and ear.

Up to release 7.0 the STMR can only be measured according to standard using ear type 3.2 (low leakage) (“3GPP STMR, LRGP Method”). Up to release 4, ear type 1 may alternatively be used for 3GPP TS 51.010 only (“3GPP GSM Rel. 4 Sidetone Masking Rating”). For these tests the mobile phone under test is installed in the LRGP (ITU-T P.76), and the receiver is sealed to the artificial ear.

From release 7.1 it is also possible to use ear type 3.3 or 3.4 for this test. “3GPP STMR, HATS Method, Nom. Vol” has to be passed in the nominal setting of the user volume control. “3GPP STMR, HATS Method, All Vol. Steps” has to be passed in all (other) settings of the volume control. From release 9 either ear type 3.3 or 3.4 has to be used, from release 10 ear type 3.3 is mandatory.

The artificial mouth generates a test signal with a sound pressure of -4.7 dBPa at the MRP (mouth reference point), and the sound pressure is measured in the artificial ear. With ear types 3.2, 3.3 and 3.4, DRP-ERP correction is applied.

The attenuation of the sidetone path is determined at each frequency according to table 1 of ITU-T P.79, and the sidetone masking rating (STMR) is calculated according to formula 5-1 of ITU-T P.79 with the weighting factors of table 3 of ITU-T P.79 taken into account. In addition, the gain of the sidetone path is displayed as a curve.

When the phone is set to nominal receiving loudness, the STMR should be within 13 dB and 23 dB according to 3GPP TS 26.131 when the LRGP method is applied. With the HATS method, the target STMR is between 12 dB and 20 dB at nominal volume setting. At all other volume settings, the STMR must not be below 8 dB with the HATS method.

From version 8.2 and 9.2 of TS 26.131 the target STMR range for the HATS method has been changed to within 13 and 23 dB. From Version 8.2. and 9.1 of TS 26.132 the weighting factors for unsealed condition of ITU-T P.79 Table B2 have to be used for the STMR calculation. These changes are taken into account with the test cases according to “Rel. 8.2+9” and later.

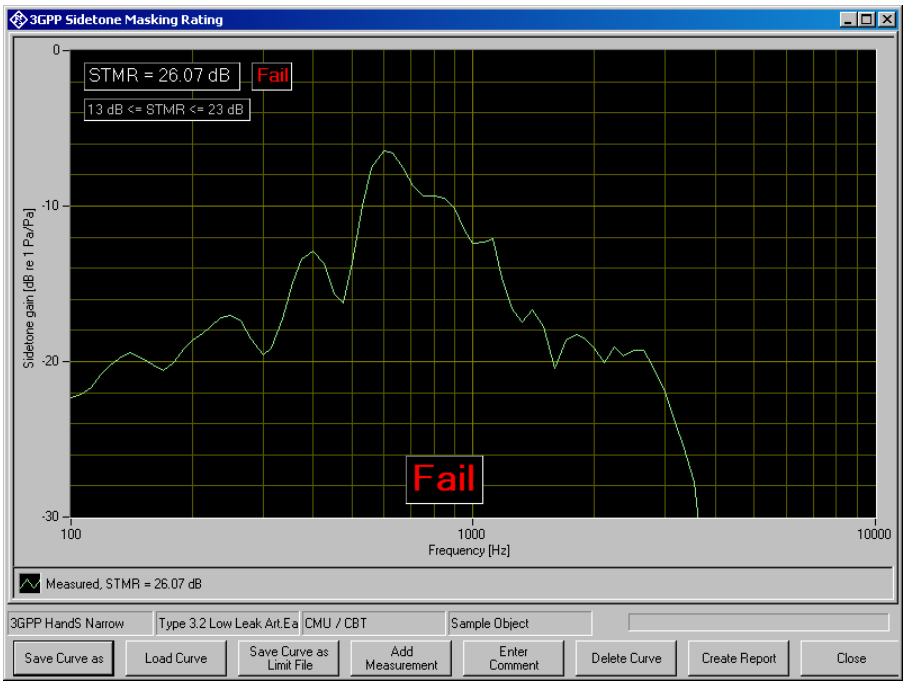


Fig. 85 Typical measurement of sidetone masking rating

STMR Tests using Artificial Voice according to ITU-T P.50 or Single-Talk Speech according to ITU-T P.501 as Test Signal

Sidetone tests are alternatively offered with artificial voice according to ITU-T P.50 or Single-Talk Speech according to ITU-T P.501 as test signal (update key UPV-K9101, UPV-K9102 or UPV-K9103 required for P.50 signal, update key UPV-K9103 required for P.501 signal).

The P.50 test signal simulates the spectrum and time structure of human voice without having any semantic content or language-specific characteristics. It consists of 10 seconds “female” voice and 10 seconds “male” voice.

The P.501 single-talk test signal contains six sentences recorded with male voices and six sentences recorded with female voices.

Other than with the modulated multisine, the reference spectra at the respective inputs of the transmission path are measured in advance and stored in files. Therefore the speech spectrum calibration for sending direction is a prerequisite for this test (see chapter 3 “Calibration”).

To make sure that the spectral transform is performed on the same portion of the test signal during reference spectrum measurement and output spectrum measurement, the output spectrum measurement is preceded by a delay measurement employing a sine burst. The start of the measurement is then delayed against the playback of the test signal by the measured amount of delay in the transmission path. If the transmission path is interrupted, e.g. due to a dropped call, the test stops with a suitable warning message.

Sidetone Delay

The sidetone delay measurement is specified from release 8 of the 3GPP specifications for wideband AMR. Digital signal processing in the sidetone path can cause a delay of the sidetone, which would result in an annoying local echo in the handset or headset.

The test according to release 8 and 9 produces a short click in the artificial mouth and analyzes the amplitude-over-time response at the artificial ear, starting from the time when the click was produced at the artificial mouth. The first occurring maximum after approx. 1 ms is associated with the acoustic propagation from the HATS mouth to the HATS ear. There may be more maxima during the first milliseconds due to different propagation paths around the head. The time difference between the last occurring maximum exceeding a pre-defined level difference to the noise floor in the observed period, and the first peak, is defined as sidetone delay. This value must not exceed 10 ms. If no significant maximum is found before 8 ms from the start of the click at the artificial mouth, the sidetone delay is defined to be smaller than 8 ms. In the measurement window, “< 8ms” is displayed as result whereas in the report the value will be simply displayed as “0 ms”.

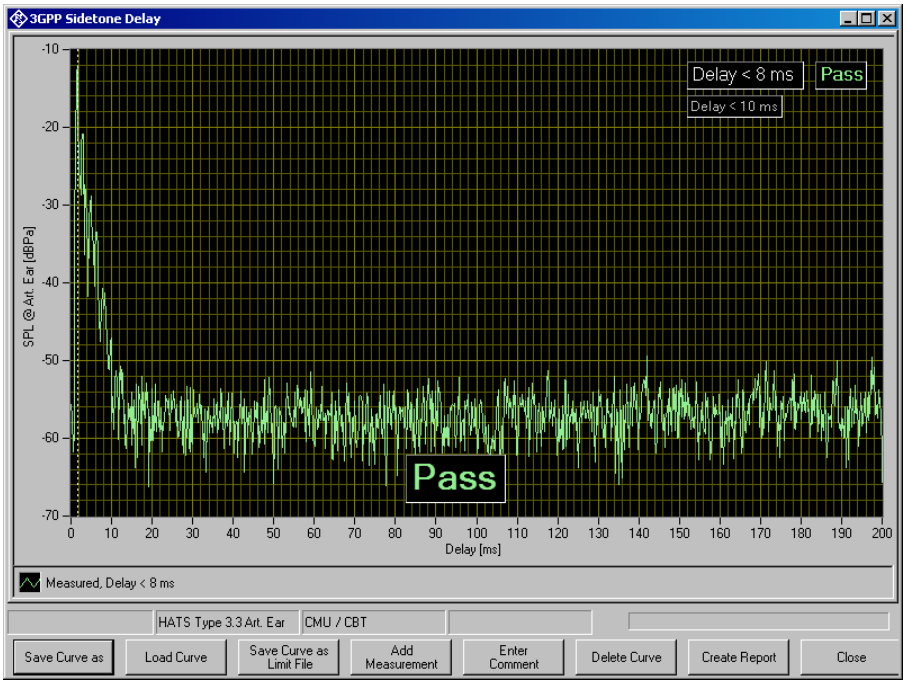


Fig. 86 Typical sidetone delay result according to release 8 and 9

From release 10 of 3GPP TS 26.132 the sidetone delay is measured by cross-correlation between the electric input signal to the artificial mouth and the electric signal from the artificial ear. The sidetone delay is defined as difference between first and second maximum of the cross-correlation envelope.

Test signal is a composite source signal (CSS) according to ITU-T P.501 which consists of a voiced part and a pseudo-noise multisine part. Before the test, the test signal is offline-filtered according to the mouth speaker equalization curve obtained during mouth calibration. This offline filtering is only performed when the valid speaker equalization curve is newer than the file with the filtered test signal.

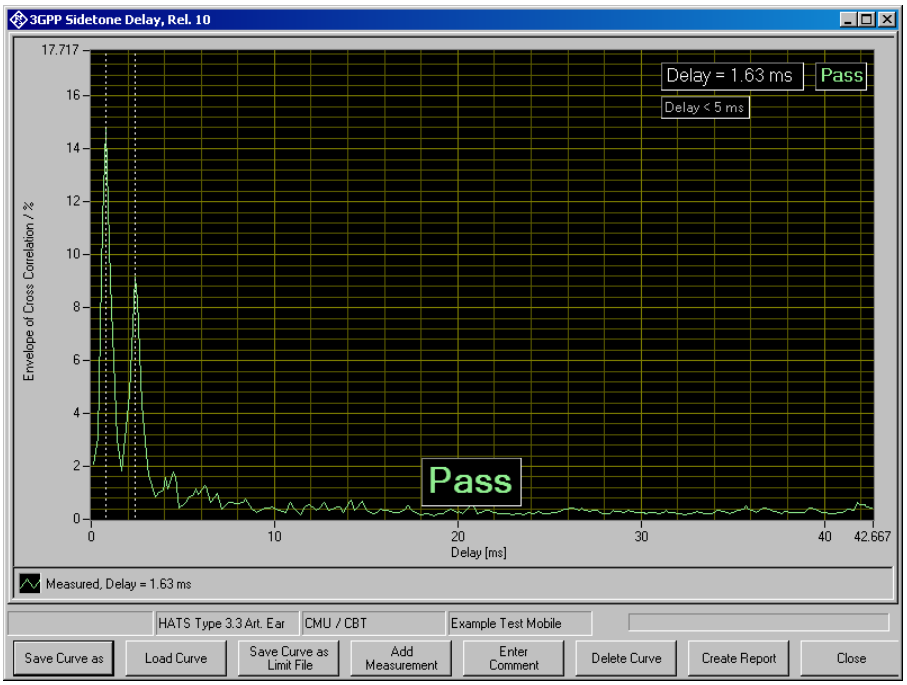


Fig. 87 Typical sidetone delay result according to release 10

Roundtrip Delay

From Release 11 of 3GPP TS 26.131 and TS 26.132 the measurement of the roundtrip delay is required. The roundtrip delay is defined as the sum of the contributions of the UE under test to the uplink and downlink end-to-end delay. To obtain the roundtrip delay value, the end-to-end delay can either be measured separately for uplink and downlink, or the loopback delay can be measured by establishing a loopback of the voice data in the system simulator. In both cases the contribution of the system simulator has to be subtracted from the measured end-to-end delay.

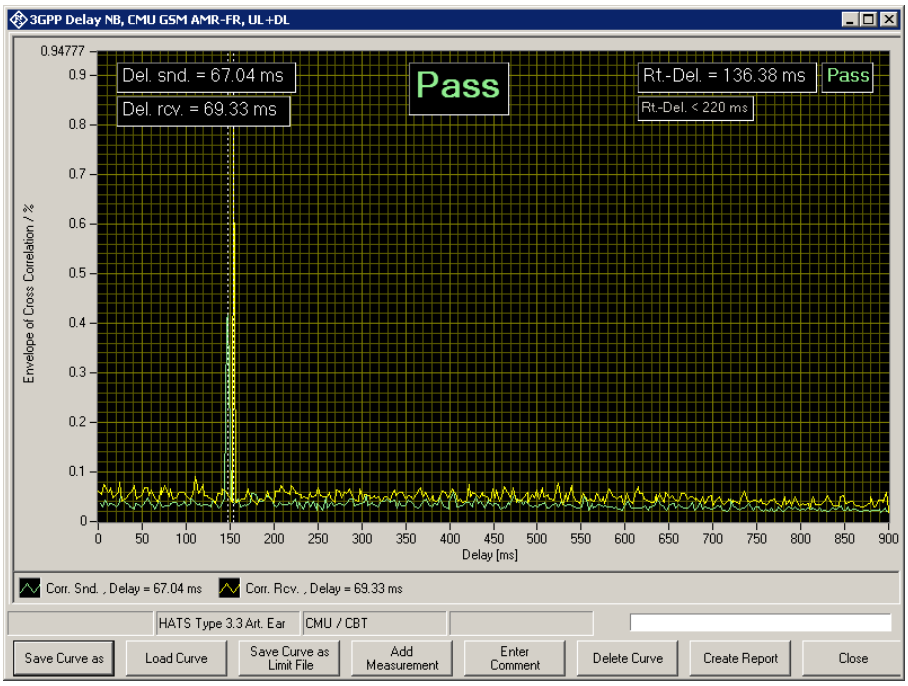


Fig. 88 Typical roundtrip delay result according to release 11

The uplink, downlink or loopback delay is measured by cross-correlation between the generator output signal and the analyser input signal.

Test signal is a composite source signal (CSS) according to ITU-T P.501 which consists of a voiced part and a pseudo-noise multisine part. For uplink and loopback on the network side the test signal is offline-filtered according to the mouth speaker equalization curve obtained during mouth calibration. This offline filtering is only performed when the valid speaker equalization curve is newer than the file with the filtered test signal.

Echo Loss (TCLw)

The echo loss is the attenuation between the speech coder input and the speech decoder output (gain of speech coder + decoder = 1). Normally the echo is caused by internal acoustic coupling between the telephone receiver and the microphone. Since the echo considerably reduces the sound transmission quality, it must not exceed a certain level.

For measurement of echo loss up to release 9 of 3GPP TS 26.132, the testing shall be made under real use environmental conditions. A typical “office-type” room should be used. The mobile phone under test is suspended in free air. From release 10, echo loss is measured with the handset or headset mounted on the HATS as for most other measurements.

A modulated multitone signal according to ITU-T P.501 is generated as a test signal and applied to the speech coder. First, the spectral energy distribution of the generated signal is measured in the third-octave bands from 200 Hz to 4 kHz. Then, the spectral distribution in the output signal of the speech decoder is measured. The echo loss is calculated from the differences of the bands according to ITU-T G.122. According to 3GPP TS26.132, the mobile phone under test has to be fed for approx. 10 s with the male and female version of artificial voice according to ITU-T P.50 prior to this measurement. This training sequence is to facilitate optimization for potential echo cancellers. A quicker test without training sequence is available as “3GPP Echo loss without training”.

The actual gain of the speech coder and decoder must also be considered in the result. These values are obtained during codec calibration.

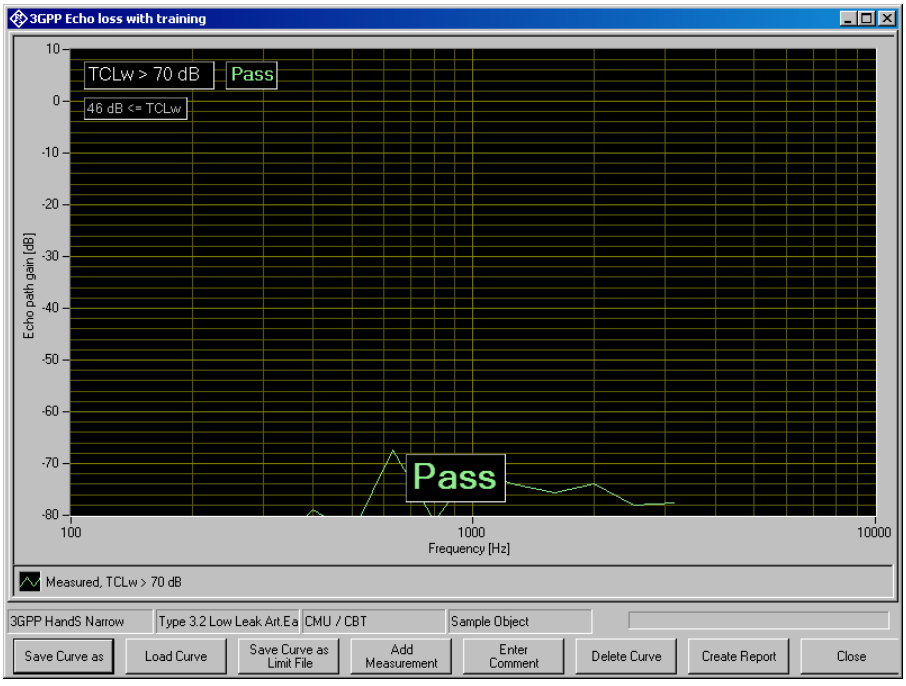


Fig. 89 Typical result of echo loss measurement

In addition, the attenuation of the echo path is displayed as a curve.

3GPP TS 26.131 specifies an echo loss of at least 46 dB; mobile phones with good echo cancellers can meet this requirement. Since the microphone of the mobile phone under test also picks up any side noise and treats it like an echo, it is essential that the test chamber is well shielded against external noise.

Stability Margin

The stability margin is measured to test the susceptibility of the phone to acoustic feedback and instability.

For the test, the telephone is placed on an even, hard board with the receiver and microphone pointing downwards.

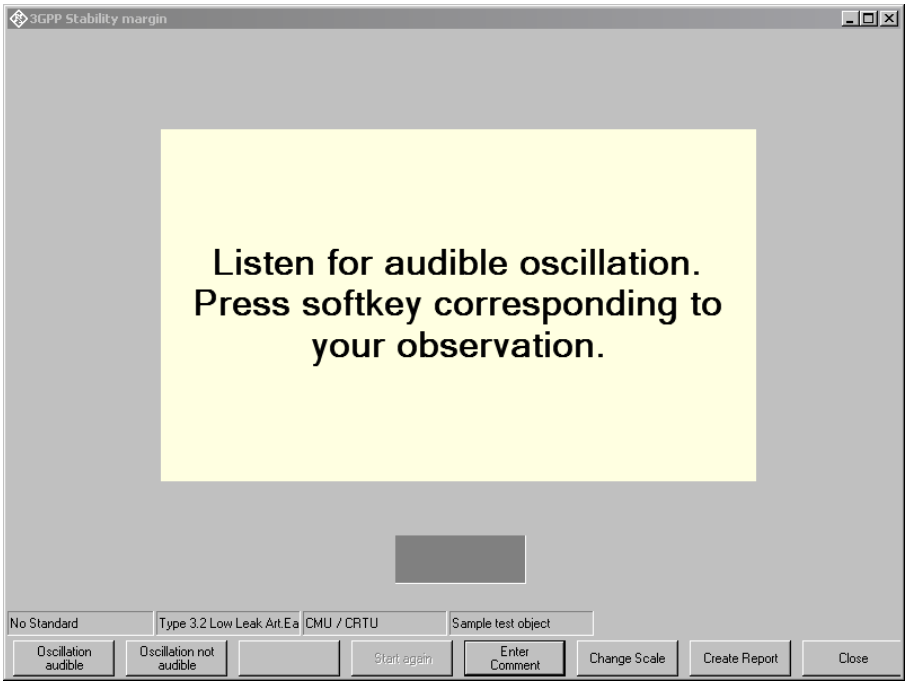


Fig. 90 Window during stability margin test

A loop is closed in the R&S UPV between the receiving and the voice channel, and an overall gain of 6 dB is set. The gain of the coder is automatically taken into account (see also Echo Loss).

To activate the loop, a noise signal of -10 dBm0 in line with ITU-T O.131 is applied for 1 s and then switched off, with the loop remaining closed.

The test person has to listen to determine whether any resonances or oscillations are produced. If there are no oscillations, the minimum requirements according to 3GPP TS 26.131 for a stability margin of 6 dB are met.

The stability margin test is specified up to release 9 of 3GPP TS 26.132.

Stability Loss

From release 10 of 3GPP TS 26.132, the stability margin test case is replaced by a stability loss test case. The test measured the attenuation between input and output of the system simulator, similar to the echo loss measurement. Other than with the echo loss measurement, the result is not integrated over frequency, but the spectral minimum is searched.

The test routine first looks for valid delay results of the selected device under test in sending and receiving direction. If no results are found, or if the delay results are older than specified in the parameters of this measurement, the UE has to be first mounted on the HATS for the delay measurements.

When valid delay values are available, the mobile has to be set up according to the following illustration:

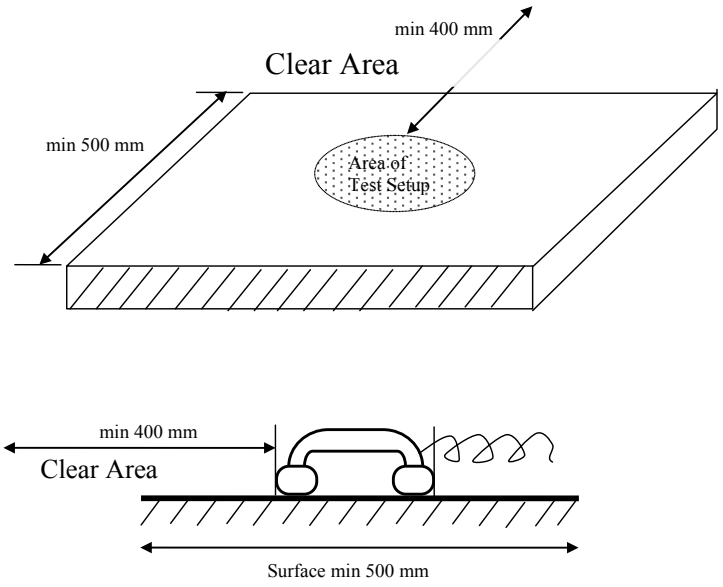


Fig. 91 Test setup for stability loss test

As soon as the operator has acknowledged the UE to be correctly placed, a PN signal with high rms level is send to the network interface, and the returned signal at the output of the system simulator after the roundtrip delay is measured. The spectral attenuation is calculated from the difference of the level spectra.

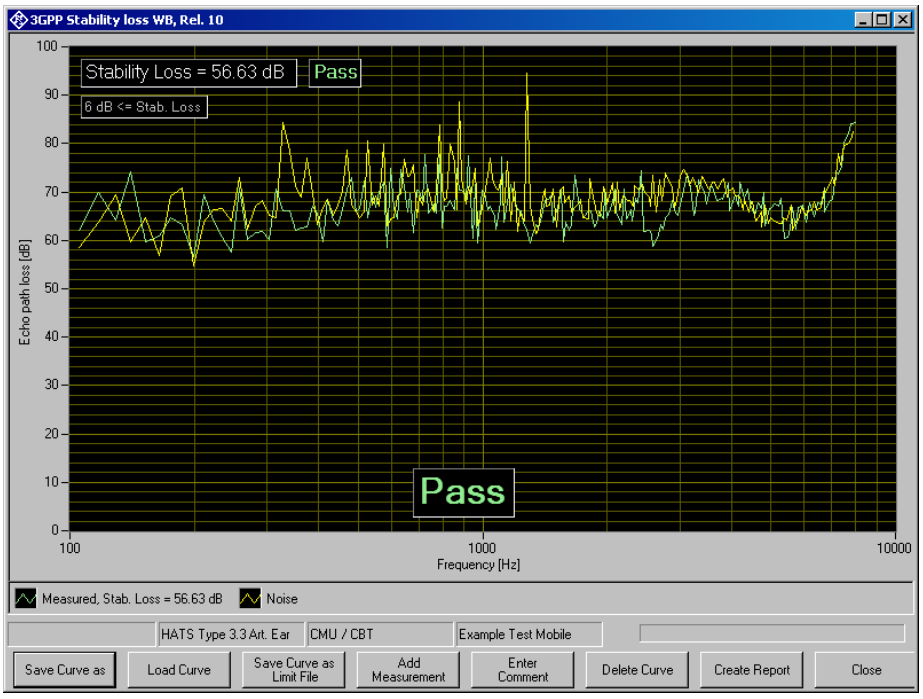


Fig. 92 Window of stability loss test

A second measurement is performed without test signal to show the noise “floor” of the measurement. As the graph plots the path loss, the noise-induced result will usually be above the stability loss result.

Echo Control Characteristics

The “Echo Control Characteristics” test has been added to 3GPP TS 26.132 in Release 11. It requires update key UPV-K9103 and option second analog generator (UPV-B3). It is a so-called “double-talk” test in which test signals are sent in both uplink and downlink direction simultaneously. The signal sent by the mobile to the network simulator is analyzed.

The uplink signal contains a section with single words separated by pauses (“single near-end words”) and a section with continuous talk (“continuous double-talk”). These sections are analysed separately.

In a first run, both uplink and downlink signals are played simultaneously. In a second run only the uplink signal is played while the downlink path is silent. The level difference between both situations is anlayzed in frames of 5 ms. The results are summarized separately for the following two categories:

“Double-talk” frames are defined as the frames where both the far-end (receiving direction) signal includes active speech (extended with a hang-over period of 200 ms) and the near-end signal is composed of active speech.

“Far-end single-talk adjacent to double-talk” frames are similarly defined as the frames with active far-end speech and no active near-end speech.

The test method measures the duration of any level difference between the sending signal of a double-talk sequence (where the echo canceller has been exposed to simultaneous echo and near-end speech) and the sending signal of the same near-end speech only. The level difference is classified for each of the two situations (with and without simultaneous downlink signal) and for each of the two classified frame categories separately into eight categories according to the following figure and table:

Fig. 93 Classification of level differences and their duration into categories

Cat	Level difference (ΔL)	Duration (D)	Description
A1	-4 dB ≤ ΔL < 4 dB		Full-duplex and full transparency
A2	-15 dB ≤ ΔL < -4 dB		Full-duplex with level loss in Tx
B	ΔL < -15 dB	D < 25 ms	Very short clipping
C	ΔL < -15 dB	25 ms ≤ D < 150 ms	Short clipping resulting in loss of syllables
D	ΔL < -15 dB	D ≥ 150 ms	Clipping resulting in loss of words
E	ΔL ≥ 4 dB	D < 25 ms	Very short residual echo
F	ΔL ≥ 4 dB	25 ms ≤ D < 150 ms	Echo bursts
G	ΔL ≥ 4 dB	D ≥ 150 ms	Continuous echo

Table 3 Description of categories

For each category, the ratio of frames in this category to the total number of frames is given, as well as the average level difference.

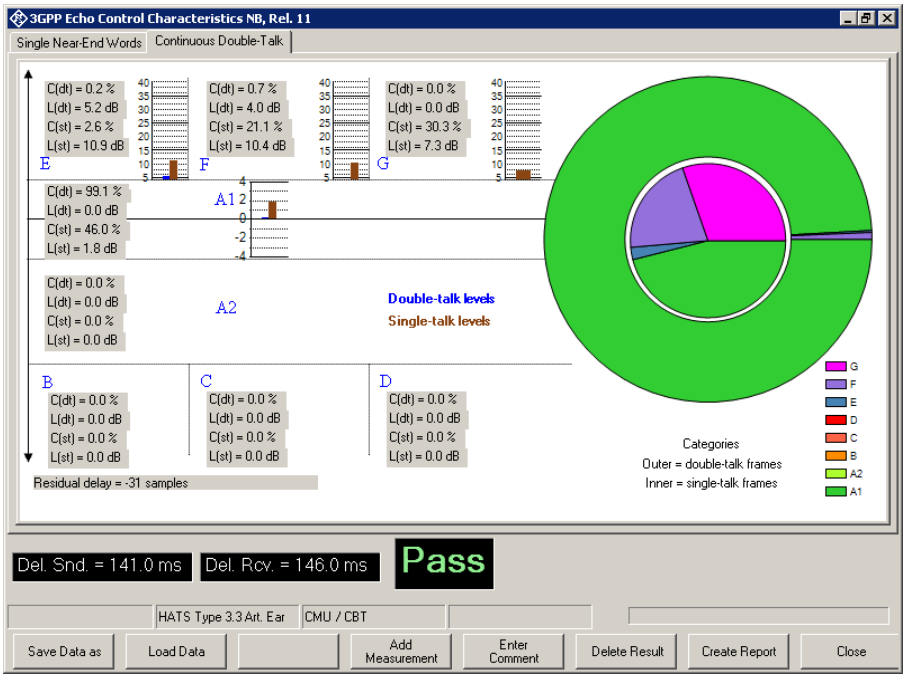


Fig. 94 Result screen of the “Echo Control Characteristics” test.

Interpretation of the results:

A positive level difference means that the level of the signal sent by the mobile is higher with simultaneous downlink speech than without. This is an indication of echo.

Short duration (category E) indicated short echo bursts.

Long duration (category G) indicates continuous echo.

A negative level difference is an indication of clipped uplink speech.

Short duration (category B) indicates short clipping, e.g. at the start of sentences or words.

Medium duration (category C) indicates loss of syllables.

Long duration (category D) indicates continuous high attenuation.

Sending Distortion

The SINAD (signal to noise and distortion) ratio in the transmit path is measured as a function of the sound level.

A pulsed sinusoidal tone with a pulse length of approx. 360 ms is used for the measurement. For tests according to up to release 8 (narrowband) and up to release 7 (wideband), the frequency of the tone is 1015 Hz. For measurements according to later releases the frequency is 1020 Hz (see also table 12 below). At these frequencies, coding yields a sufficiently stable output signal. Voice activity detection continues to be active in the mobile phone under test due to this pulsating signal.

The mobile phone under test is installed in the LRGP or on the HATS.

The test signal is generated with the artificial mouth at the MRP (mouth reference point) and the SINAD value of the received signal is measured at the R&S CMU200 decoder output.

The acoustic reference level (ARL) is defined as the sound pressure which creates a signal level of -10 dBm0 in the transmit channel. An automatic routine varies the sound pressure at the artificial mouth until the desired level is attained. This value is then used as a reference for determining the SINAD value versus level.

The SINAD value is measured at sound pressures between -35 dB and +10 dB relative to the acoustic reference level (ARL) and compared with the limits specified in table 7 of 26.131 of 3GPP.

Signal processing of a modern mobile phone comprises a voice activity detector which determines whether a voice signal is present or whether the sending signal just comprises background noise. With such mobile phones the sending distortion test according to 3GPP TS 26.132 before release 6.0.0 may be failed at low levels because the 1 kHz sinewave test signal is classified as background noise and suppressed. For this reason the sending distortion measurement according to release 6.0.0 and onwards omits levels below -25 dB and starts at high test tone levels gradually reducing the level. For this release, use “3GPP Distortion sending, Rel. 6”, for earlier releases use “3GPP Distortion sending, Rel. 4/5”.

The measurement is performed up to a maximum sound pressure of 10 dBPa at the artificial mouth if the value 10 dB relative to ARL with 10 dBPa cannot be attained. The actual trace may therefore end at a lower pressure. This occurs for mobile phones under test which have a low sensitivity in the transmit direction.

If the measured trace is above the limit line, PASS is output, otherwise FAIL is displayed.

Fig. 95 Sending distortion measurement

For tests in WB-AMR mode starting from release 8 of 3GPP TS 26.131 and TS 26.132, additional measurements are performed at the frequencies of 315 Hz, 408 Hz, 510 Hz and 816 Hz with a SPL of -4.7 dBPa at the MRP. Other than in the previous version of the test, the levels are not defined relative to ARL, but as absolute SPL at the MRP. A MMS activation signal is issued before each measurement to activate the VAD (voice activity detector) of the mobile under test. To avoid an impact of the activation signal on the result due to the processing delay in the transmission chain, the test routine comprises a delay measurement. The start of the analysis is delayed against the start of the test signal by the measured delay time.

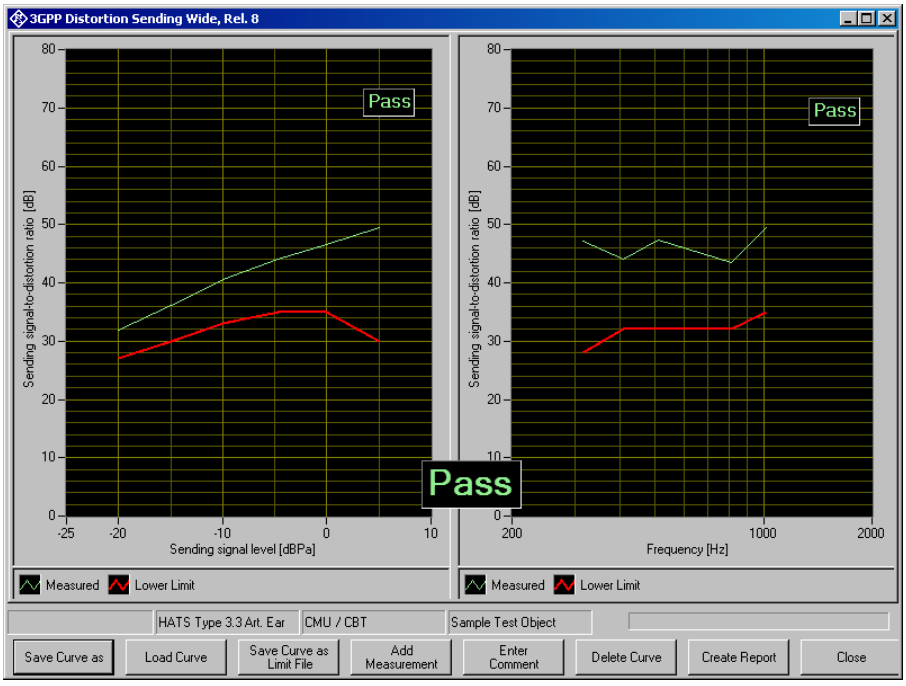


Fig. 96 Sending distortion measurement for wideband according to release 8

From release 9, version 9.2 of 3GPP TS 26.132, a CSS activation signal is recommended for test of narrowband and wideband terminals. Alternatively an activation signal specified by the terminal manufacturer may be used. Update key UPV-K9101 or UPV-K9102 is required for this version of the distortion test.

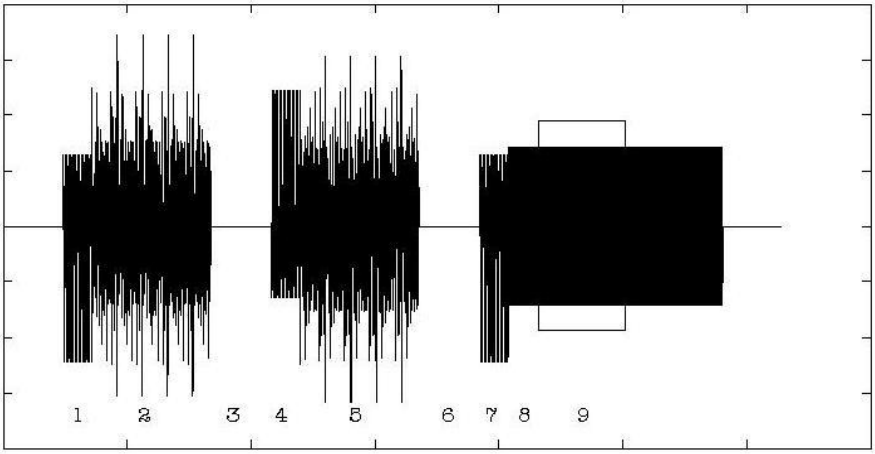


Fig. 97 Recommended activation signal according to version 9.2

The UPV-K9x software provides the CSS activation signal as a default. However, before first use the signal has to be imported using “Options → Activation Signal → Import” (see Chapter 2). This step checks the conditions on the wav file and calculates the active level of the signal. With the same menu item also other wave files can be imported for use as activation signal. The wav files must be mono with 48 kHz sampling frequency and have a duration of 10 seconds or less.

For the sending direction the activation signal must be pre-equalized according to the inverse frequency response of the artificial mouth. This can be done during import of the wav file. After a re-calibration of the artificial mouth, the equalization has become obsolete and has to be re-done. The macro for the test case automatically detects an obsolete equalization of the activation signal and does a new equalization before the test is started.

If more than one activation signal is imported at the same time, the signal to be used can be globally chosen with menu item “Options → Activation Signal → Select”. In addition, the measurement definition for this test case has a parameter to specify the file name without extension of the activation signal to be used. If this parameter is provided, it overrides the global choice of the activation signal. Thus the test can be repeated several times within a sequence, using different activation signals.

The test macro for distortion tests with activation signals from wav files also provides a spectrum display of the signal sent by the mobile. This is provided for information e.g. for troubleshooting purpose.

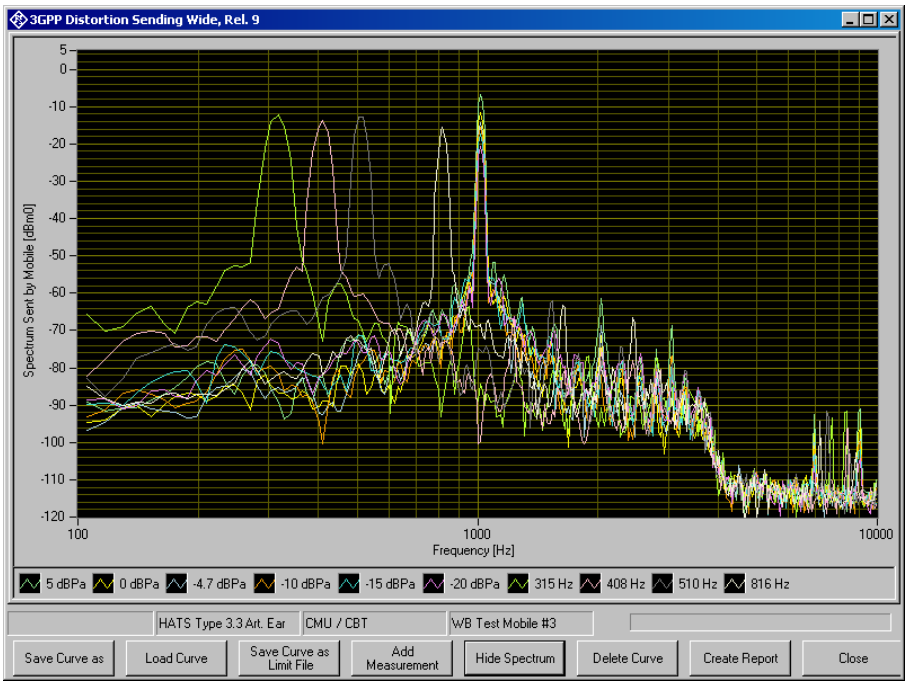


Fig. 98 Spectrum display of the sending distortion test

During the test, the latest spectrum is displayed. After the test has finished, button “Show Spectrum” or “Hide Spectrum”, respectively, toggles between spectrum display and result display. In this state the spectra to be displayed can be configured in the context menu of the graph, and the spectra can be exported to ASCII files.

The spectrum display is only available for distortion tests according to release 9 and later.

Receiving Distortion

The SINAD (signal to noise and distortion) ratio in the receiving path is measured as a function of the acoustic signal level.

A pulsed sinusoidal tone is used for the measurement. For tests according to up to release 8 (narrowband) and up to release 7 (wideband), the frequency of the tone is 1015 Hz. For measurements according to later releases the frequency is 1020 Hz (see also table 12 below). At these frequencies, coding yields a sufficiently stable output signal.
Voice activity detection continues to be active in the mobile phone under test due to this pulsating signal.

The mobile phone under test is installed in the LRGP (ITU-T P.76) with the receiver is sealed to the artificial ear, or on the HATS.

The test signal is applied to the input of the R&S CMU200 speech coder, and the SINAD value of the sound pressure in the artificial ear is measured with psophometric weighting according to ITU-T G.714.

The SINAD value of the sound pressure is measured at levels between -45 dBm0 and 0 dBm0 and compared with the limits given in table 8 of 3GPP TS 26.131.

The measurement is performed up to a maximum sound pressure of 10 dBPa in the artificial ear; the actual trace may end at an earlier point.

If the operator desires to see the receiving distortion value at the point exceeding 10 dBPa, this can be achieved by pressing the “add measurement” button. This causes the measurement to be repeated at

all specified levels. The second measurement is not taken into account for reporting and Pass/Fail decision.

If the measured trace is above the limit line, PASS is output, otherwise FAIL is displayed.

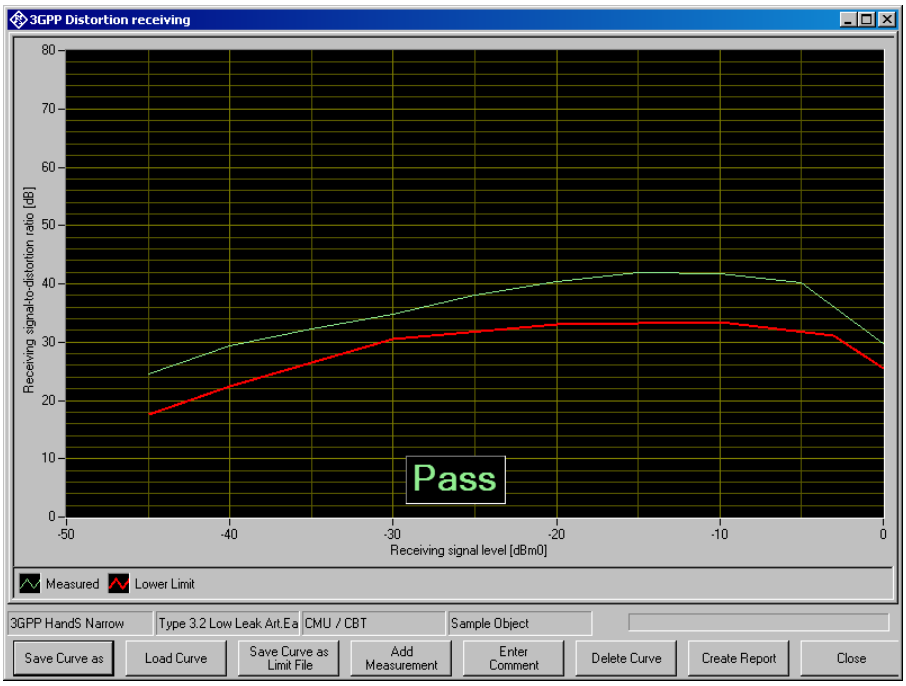


Fig. 99 Typical result of receiving distortion measurement

For tests in WB-AMR mode starting from release 8 of 3GPP TS 26.131 and TS 26.132, additional measurements are performed at the frequencies of 315 Hz, 408 Hz, 510 Hz and 816 Hz with a digital level of -16 dBm0 at the network interface (encoder input). An activation signal precedes the test signal. To avoid an impact of the activation signal on the result due to the processing delay in the transmission chain, the test routine comprises a delay measurement. The start of the analysis is delayed against the start of the test signal by the measured delay time.

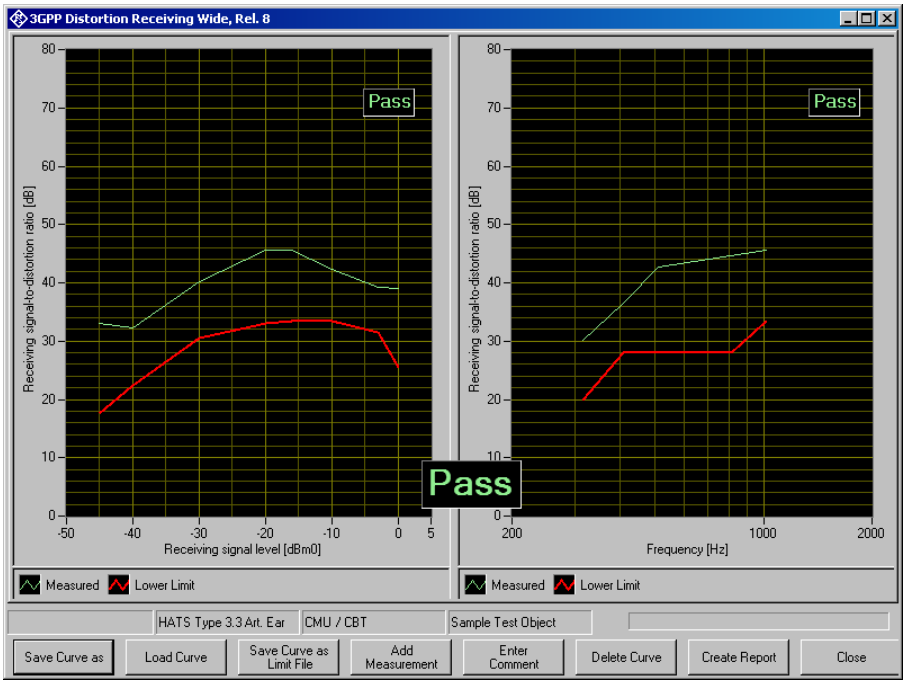


Fig. 100 Typical result of receiving distortion measurement in wideband according to release 8.

From release 9, version 9.2 of 3GPP TS 26.132, a CSS activation signal is recommended for test of narrowband and wideband terminals (see previous section about sending distortion tests). Alternatively an activation signal specified by the terminal manufacturer may be used. Update key UPV-K9101 or UPV-K9102 is required for this version of the distortion test.

The UPV-K9x software provides the CSS activation signal as a default. However, before first use the signal has to be imported using “Options → Activation Signal → Import” (see Chapter 2). This step checks the conditions on the wav file and calculates the active level of the signal. With the same menu item also other wave files can be imported for use as activation signal. The wav files must be mono with 48 kHz sampling frequency and have a duration of 10 seconds or less.

If more than one activation signal is imported at the same time, the signal to be used can be globally chosen with menu item “Options → Activation Signal → Select”. In addition, the measurement definition for this test case has a parameter to specify the file name without extension of the activation signal to be used. If this parameter is provided, it overrides the global choice of the activation signal. Thus the test can be repeated several times within a sequence, using different activation signals.

The test macro for distortion tests with activation signals from wav files also provides a spectrum display of the signal output at the earpiece of the mobile. This is provided for information e.g. for troubleshooting purpose.

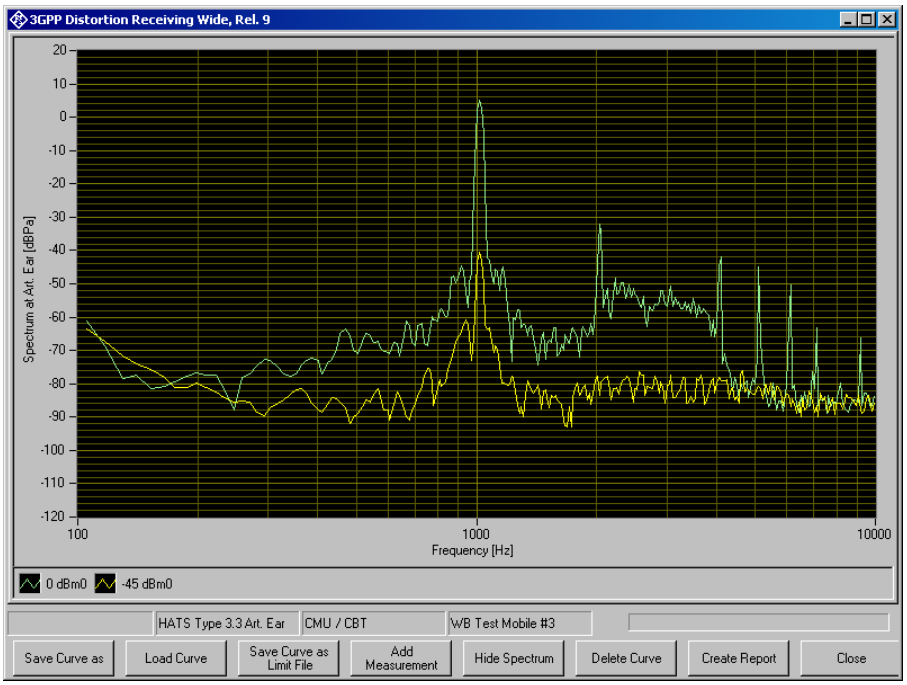


Fig. 101 Spectrum display of the receiving distortion test

During the test, the latest spectrum is displayed. After the test has finished, button “Show Spectrum” or “Hide Spectrum”, respectively, toggles between spectrum display and result display. In this state the spectra to be displayed can be configured in the context menu of the graph, and the spectra can be exported to ASCII files.

The spectrum display is only available for distortion tests according to release 9 and later.

Idle Channel Noise Sending

The noise voltage at the speech decoder output is measured with the phone set up in a quiet environment (< 30 dB(A)).

The mobile phone under test is installed in the LRGP (ITU-T P.76) or on the HATS.

The decoder output voltage is measured, weighted and recalculated for the internal level in dBm0p.

For the narrow band test, the weighting is done psophometrically according to ITU-T G.223. For the wideband version of the test, A weighting according to IEC 60651 is applied.

To keep the mobile phone under test in the normal operating mode, a pulsed signal is applied. The noise level is measured during the signal pauses. The voice activity decoder (VAD) is activated and the mobile phone remains in the active normal sending mode.

The idle noise level should not exceed -64 dBm0p. The measured noise voltage is also displayed as a spectrum, making it easier to find causes if the limit value is exceeded.

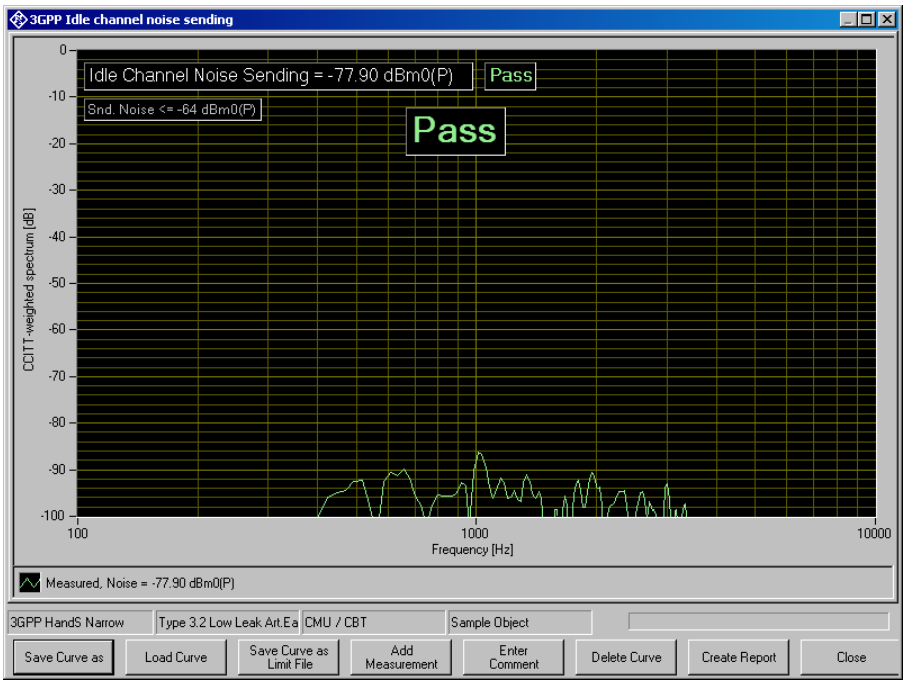


Fig. 102 Typical result of sending noise measurement

The idle channel noise test employs a sinewave activation signal to activate the sending path of the mobile. To avoid the activation signal leaking into the measurement, a delay measurement is performed first. If the signal path is interrupted, e.g. due to a dropped call, the measurement is aborted with a suitable message.

From release 10 of 3GPP TS 26.132, idle channel noise measurements also comprise the determination of a spectral maximum to detect single-frequency disturbances. The spectral maximum is determined from a 8192 points FFT in a 48 kHz sample rate system. The test system averages five subsequent measurements, whereby spectral maxima to be averaged can occur at different frequencies during averaging. This version of the idle channel noise test requires update key UPV-K9102.

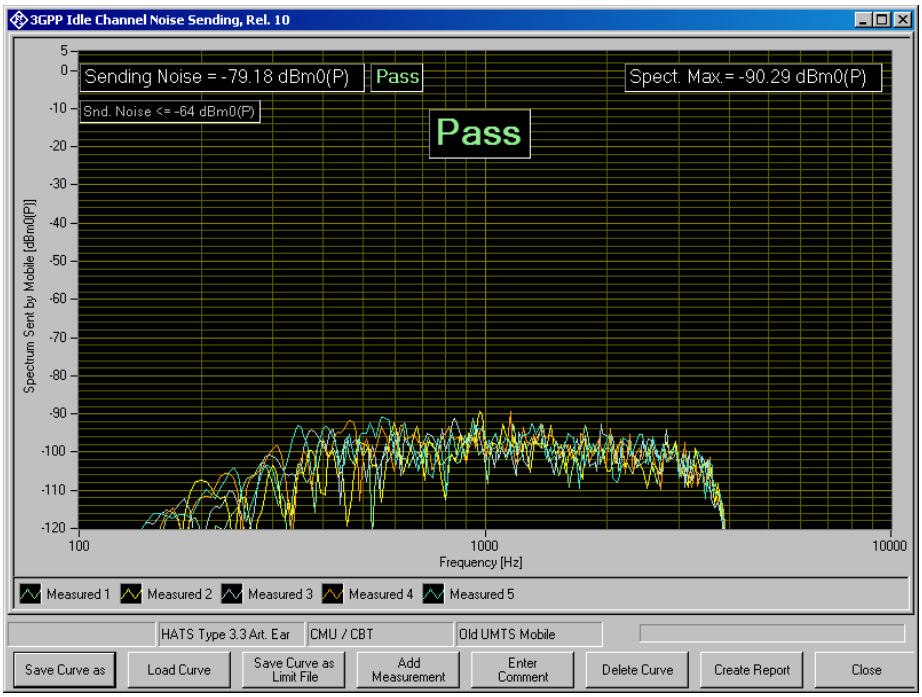


Fig. 103 Sending noise measurement according to release 10

Idle Channel Noise Receiving

The sound pressure in the artificial ear is measured with the phone set up in a quiet environment.

The mobile phone under test is installed in the LRGP (ITU-T P.76) with the receiver sealed to the artificial ear, or mounted on the HATS.

The sound pressure in the artificial ear is measured with A-weighting on.

To keep the mobile phone under test in the normal operating mode, a pulsed signal is applied to the speech coder input. The noise level is measured during the signal pauses. The voice activity decoder is activated and the mobile phone remains in the active normal receiving mode.

With rated loudness set on the mobile phone, the sound pressure should not exceed -57 dBPa(A). In this case use test “3GPP Idle channel noise receiving, nom. Vol”.

At maximum receiving loudness, the sound pressure should not exceed -54 dBPa(A). In this case use test “3GPP Idle channel noise receiving, max. Vol”.

The measured noise voltage is also displayed as a spectrum, making it easier to find causes if the limit value is exceeded.

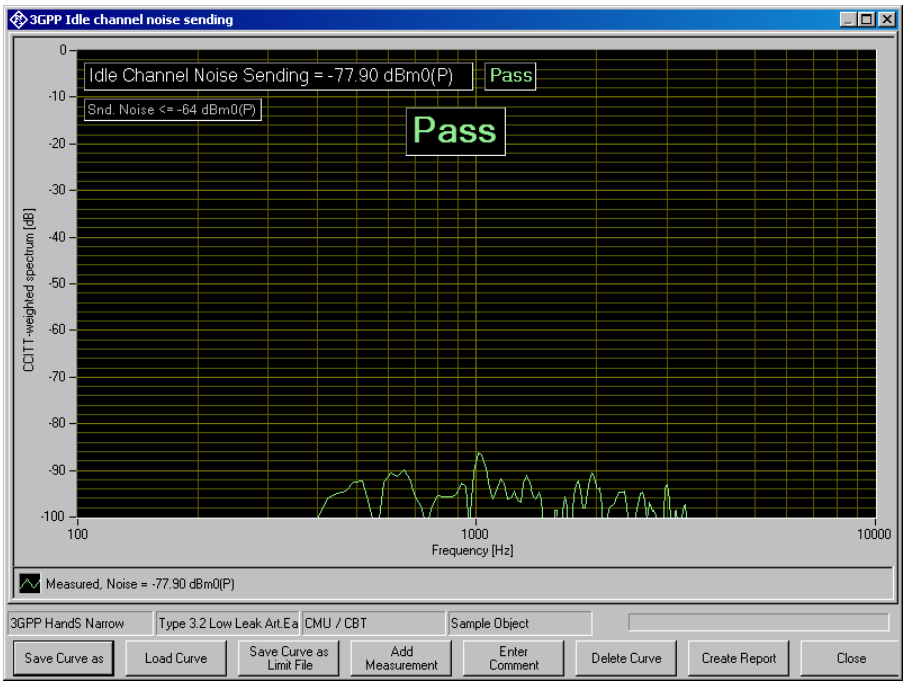


Fig. 104 Typical result of receiving noise measurement

The idle channel noise test employs a sinewave activation signal to activate the sending path of the mobile. To avoid the activation signal leaking into the measurement, a delay measurement is performed first. If the signal path is interrupted, e.g. due to a dropped call, the measurement is aborted with a suitable message.

From release 10 of 3GPP TS 26.132, idle channel noise measurements also comprise the determination of a spectral maximum to detect single-frequency disturbances. The spectral maximum is determined from a 8192 points FFT in a 48 kHz sample rate system. The test system averages five subsequent measurements, whereby spectral maxima to be averaged can occur at different frequencies during averaging. This version of the idle channel noise test requires update key UPV-K9102.

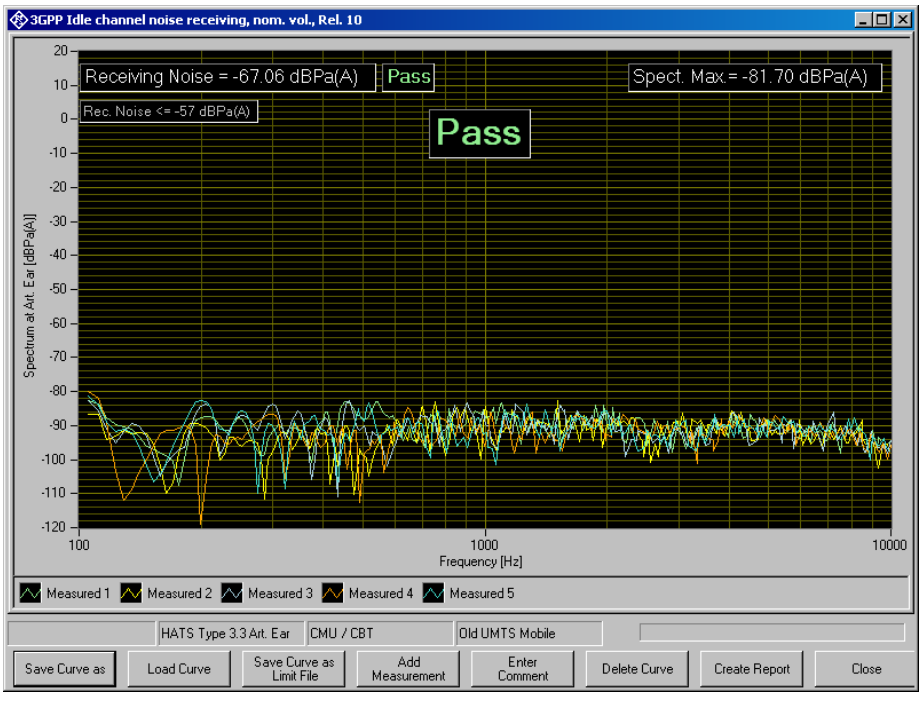


Fig. 105 Receiving noise measurement according to release 10

This measurement makes high demands on the sound insulation of the test chamber and the S/N ratio of the measuring microphone including preamplifier in the artificial ear. A comparison measurement with the test mobile phone switched off or without a DUT shows the measurement reserves of the test equipment. Due to the low inherent noise of the Audio Analyzer R&S UPV, measurements can be made to about -80 dBPa(A) at 0 dB microphone gain, and even to lower values when a higher microphone gain is set.

Ambient Noise Rejection

Ambient noise rejection describes the weighted ratio of voice signal transmission to transmission of ambient noise. An ANR value >0 dB means that voice as the useful signal is transmitted more loudly than any ambient noise. The minimum requirement according to 3GPP TS 26.131 is ANR > 0 dB. A value >= 3 dB is recommended. From version 5.1 (with the exception of wideband measurement according to release 6 and 7), an additional allowance of 3 dB should take measurement tolerances into account, such that the effective minimum value is -3 dB.

To perform this measurement, a homogeneous noise field for simulating the noise in the environment has to be generated. This sound field must be generated by additional loudspeakers and noise generators. To obtain a sufficiently homogeneous sound field, several uncorrelated generators and loudspeakers are required. The use of 2 to 8 generators and loudspeakers is common practice. The noise sources have to generate pink noise (spectral power density ~ 1/f). The permissible error in the relevant third-octave bands must be smaller than ±3 dB with the frequency response of the loudspeakers used also being taken into account. Please refer to application note 1GA51, available on the R&S download web site, for suggestions how to generate the noise field for the ambient noise rejection test.

The adjustment and testing of the sound field is done as a calibration process (see section 4 above). With sufficient long-term stability of the noise generators and loudspeakers it can be used for a number of subsequent tests. Alignment of the noise field has to be repeated if anything in the setup of the noise sources (loudspeaker position, amplifier gain etc.) is changed. Furthermore it is recommended to check the noise field in regular intervals.

After the noise field calibration, the artificial mouth and the artificial ear must be installed again for the actual measurement of ANR. The MRP must be installed at the same position as the reference microphone had during the calibration of the noise field.

The mobile phone under test is installed in the LRGP (ITU-T P.76) or on the HATS (ITU-T P.58). If installed on the LRGP, the receiver is sealed to the artificial ear.

Set up a call to the R&S CMU200 and set the bit stream to "Handset Low" (GSM) or the dedicated channel voice to "Speechcodec Low" (WCDMA).

At first the noise spectrum picked up by the phone and sent on the uplink is measured. After completion of the measurement, the request to switch off the noise field will be displayed on the screen. If this is confirmed, the speech sending sensitivity will be measured automatically and the ANR value will be calculated afterwards.

The minimum value in the tests named "…, w. 3 dB uncert. allow." is -3 dB. In all other ANR tests the minimum requirement is 0 dB.

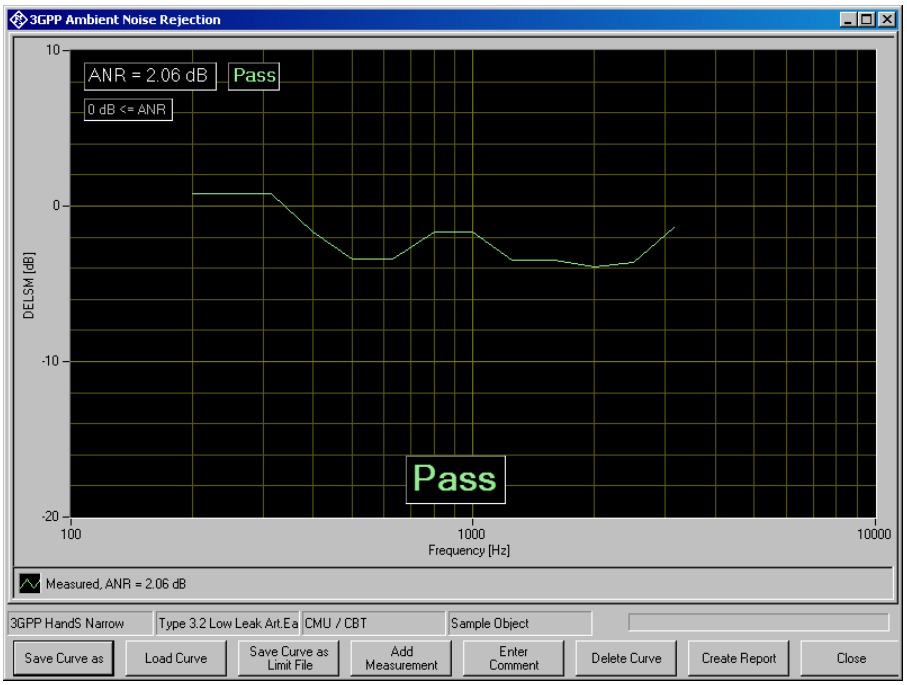


Fig. 106 Typical result of ambient noise rejection measurement

The graph displays the difference of the room noise sensitivity and the speech sending sensitivity (DELSM) for information.

Speech Quality in Presence of Ambient Noise

Setup

Fig. 107 Setup for measurement “speech quality in presence of background noise”

The arrangement of the elements in the block schematic does not reflect the physical setup in the test room. See ETSI ES 202396-1 for details on the requirements for the test room and the speaker setup. For the speaker positioning the following rules and advice apply:

- The four full-range speakers are to be arranged in a square

- Distance of each of the four full-range speakers from the center of the HATS is 2m
- Avoid positioning any speaker in any of the room corners
- Avoid positioning of speakers including subwoofer or HATS exactly
  in the room center or at one half, one third or one fourth of the room length or width

Connections

Connect

1. LAN socket of UPV to LAN socket of UPP
2. UPP trigger output to UPV trigger input
3. UPP-Z8A output 3 to input of front left active speaker
4. UPP-Z8A output 4 to input of rear left active speaker
5. UPP-Z8A output 5 to input of front right active speaker
6. UPP-Z8A output 6 to input of rear right active speaker
7. UPP-Z8A configured subwoofer output (by default 7) to input of active subwoofer
8. UPV generator output 1 to artificial mouth via drive amplifier
9. Artificial ears to microphone power supply during noise field calibration
10. During the acquisition for the speech quality evaluation, a ¼" microphone is connected to UPV analyzer input 1 via the microphone power supply
11. Output 1 of the USB sound card to UPV analyzer input 2.

Prerequisites

- Reference Microphone Calibration
- Artificial Mouth Calibration
- Codec Calibration
- Noise Field Calibration

Measurement

Place the reference microphone close to the opening of the UE's main microphone.

Start the test case from the "Measurement" or "Standard" menu. The test will start right away in the following processing order:

1. Measurement of uplink delay
2. Acquisition of unprocessed signal and processed signal for all ambiances
3. Processing of the acquired signals with simultaneous display of the results according to the progress
4. Deleting of temporary files.

Each measurement can be repeated by clicking "Repeat current sequence" in the status box:

Fig. 108 Setup for measurement “speech quality in presence of background noise”

The “cancel” button cancels the complete measurement.

The button with the crossed speaker symbol stops the playback of the noise and test signal and aborts the current acquisition which can be repeated thereafter.

Results are S-MOS, N-MOS and G-MOS for each ambience and overall average. The green values are the averages over all sentences, and the grey values are the standard deviations between the sentences.

ANR Tests using Artificial Voice according to ITU-T P.50 as Test Signal

Sending, receiving, sidetone and ambient noise rejection tests are alternatively offered with artificial voice according to ITU-T P.50 as test signal. This version of the ambient noise rejection test requires update key UPV-K9101 or UPV-K9102.

The test signal simulates the spectrum and time structure of human voice without having any semantic content or language-specific characteristics. It consists of 10 seconds “female” voice and 10 seconds “male” voice.

Other than with the modulated multisine, the reference spectra at the respective inputs of the transmission path are measured in advance and stored in files. Therefore the speech spectrum calibration for sending direction is a prerequisite for this test (see chapter 3 “Calibration”).

To make sure that the spectral transform is performed on the same portion of the test signal during reference spectrum measurement and output spectrum measurement, the output spectrum measurement is preceded by a delay measurement employing a sine burst. The start of the measurement is then delayed against the playback of the test signal by the measured amount of delay in the transmission path. If the transmission path is interrupted, e.g. due to a dropped call, the test stops with a suitable warning message.

Notes on Hands-Free Measurements

General Remarks

The standards 3GPP TS 26.131 and TS 26.132 define requirements and test specifications for the tests of the acoustic behaviour of the mobile phone in this mode, but not all details are specified yet.
R&S UPV-K91 3GPP Mobile Phone tests provide test cases for handheld hands-free and desktop hands-free mode with narrow band and wideband speech. Test specifications and limits for hands free car kits are the same as for desk top hands-free terminals.

Hands-free tests with R&S UPV-K91 support the use of either artificial mouth according to ITU-T P.51 together with a free field measurement microphone or alternatively the use of a HATS with type 3.3 or 3.4 artificial ear and artificial mouth according to ITU-T P.58.

Test Setup

All tests must be performed in an anechoic room. Background noise must be less than 24 dBSPL(A). Furthermore the room should be big enough and its walls should have sufficient absorption to provide nearly free-field conditions at the hands-free reference point. Not all test boxes which are appropriate for handset tests can be used for hands free measurements.

If a free-field microphone with a discrete P. 51 mouth is used, it should be configured to the Handheld hands-free UE as per Figure 58 for receiving measurements and Figure 59 for sending measurements. The measurement instrument should be located at a distance d_{HF} from the centre of the visual display of the mobile station. The distance d_{HF} is specified by the manufacturer.

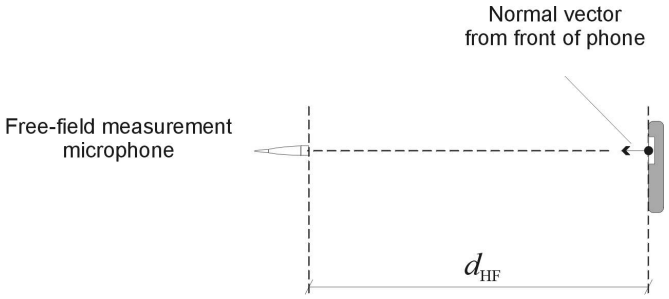


Fig. 109 Configuration of handheld hands-free UE, free-field microphone for receiving measurements

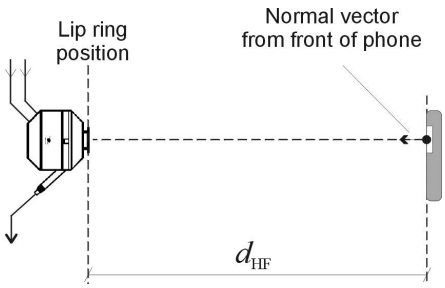


Fig. 110 Configuration of handheld hands-free UE and artificial mouth according to ITU-T P.51 for sending measurements

If a HATS is used, the measurement can either be performed binaurally (with two artificial ears and correction of the RLR by 6 dB) or monaural.

The selection of acoustic accessories used for the hands free tests can be entered in menu item “Options → Hands free settings”.

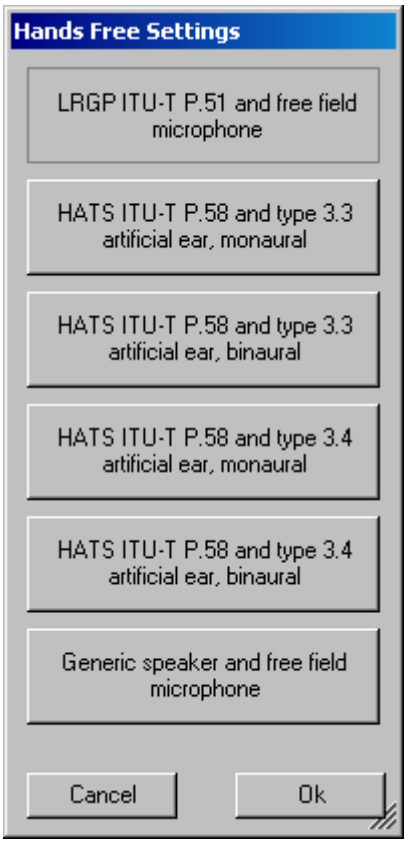

Hands Free Settings
LRGP ITU-T P.51 and free field microphone
HATS ITU-T P.58 and type 3.3 artificial ear, monaural
HATS ITU-T P.58 and type 3.3 artificial ear, binaural
HATS ITU-T P.58 and type 3.4 artificial ear, monaural
HATS ITU-T P.58 and type 3.4 artificial ear, binaural
Generic speaker and free field microphone
Cancel
Ok

Fig. 111 Hands free settings

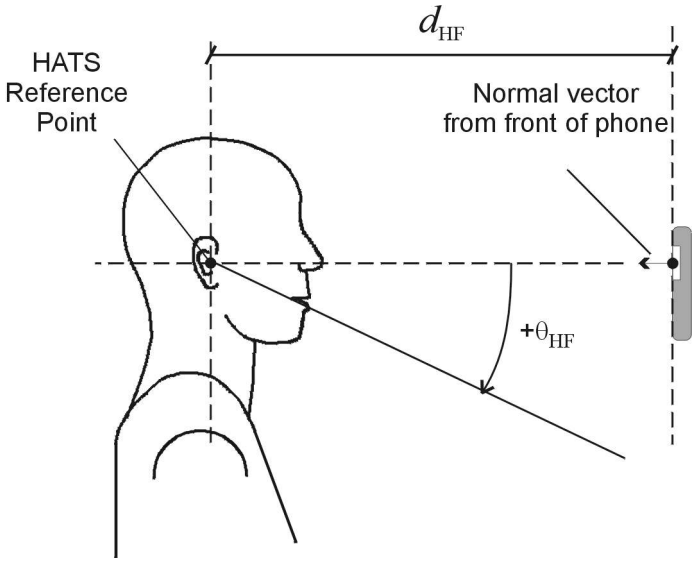


Fig. 112 Configuration of handheld hands-free UE with HATS

For desk top hands-free it is referred to ITU-T P. 340 (http://www.itu.int) for the use of free field microphone and discrete P.51 mouth. The hands free terminal should be placed on a table of approximately 1 m^2 with the centre of its front edge 400 mm perpendicularly from the centre of the front edge of the table. The surface area should not be less than 0.96 m^2 and its width should not be less than 0.8 m. The front centre of the measuring microphone or centre of the lip ring, respectively, should be placed 300 mm above the centre of the front edge of the table with the axis of the microphone or artificial mouth inclined towards the centre of the front edge of the hands-free terminal.

For the use of a HATS with both types of hands-free terminals it is referred to ITU-T P.581. For handheld hands free the setup of ITU-T P.581 corresponding to “portable hands-free” should be used. For desk top hands-free, the centre of the lip ring is positioned as described above, but the axis of the artificial mouth should be horizontal.

Acoustic Calibration for Hands Free Tests

The calibration for the free field microphone or type 3.3 or type 3.4 HATS ear, respectively, is done as described in chapter 4 above.

For binaural measurements, the second artificial ear has to be calibrated accordingly, using the sub-item “Second Type 3.3 ear” or “Second type 3.4 ear”, respectively, in “Calibration → Artificial Ear”. Note that the second artificial ear must be connected to Analyzer input 2 instead of the R&S CMU200 connection.

According to 3GPP TS 26.132, free field equalization has to be taken into account. Free field data can either be imported as an average table from the standard or from an individual calibration disk, using the menu item “Calibration → Free field equalization”.

The calibration of the artificial mouth for hands free tests comprises two additional steps. After the level has been adjusted and the frequency response has been equalized at the MRP, the reference microphone has to be repositioned at the so-called Hands-Free Reference Point (HFRP or HATSHFRP).

For the mouth according to ITU-T P.51 the HFRP is in 50 cm distance from the lip ring on the axis of the mouth. The calibration has to be performed at this point independent of the measuring distance currently used.

The HATS HFRP is stipulated in ITU-T P.581. It is one of the points 11 to 17 defined in table 6a of ITU-T P.58. It should be on the axis which is closest to the actual axis from the lip ring to the microphone under test. The distance is always 50 cm from the lip ring. The axis may be azimuthally centric (i.e. 0° horizontally) with an elevation (vertical) angle of 0°, ±15° or ±30°. Points 16 and 17 are located on an axis with 0° elevation and an azimuth angle of 15° or 30°.

The level at this point is adjusted to -28.7 dBPa. For the last step, the reference microphone is returned to the MRP, and the level and spectrum at the MRP are measured as reference for the transfer function calculation.

The mouth calibration for hands-free tests is started with the menu item “Calibration → Artificial Mouth (Hands Free)”. This procedure comprises the mouth calibration for handset tests and has also effect on subsequent handset tests with the same individual artificial mouth.

“Utilites” Measurements

This item of the “Standards” menu contains useful measurements which are either from other standards or for checking test conditions.

Sidetone Distortion

A sidetone distortion test is specified in 3GPP TS 51.010 30.8 for measurements using the DAI. As the downlink conveys only silence during this test, it is, however, more or less independent of the kind of transmission between system simulator and mobile. The sidetone distortion test determines 3rd order harmonic distortion at a given set of frequencies (in the case of TS 51.010 at 315, 500 and 1000 Hz) with a level of -4.7 dBPa at the MRP. The third order harmonic distortion is required to be less than 10 % (-20 dB) at all frequencies.

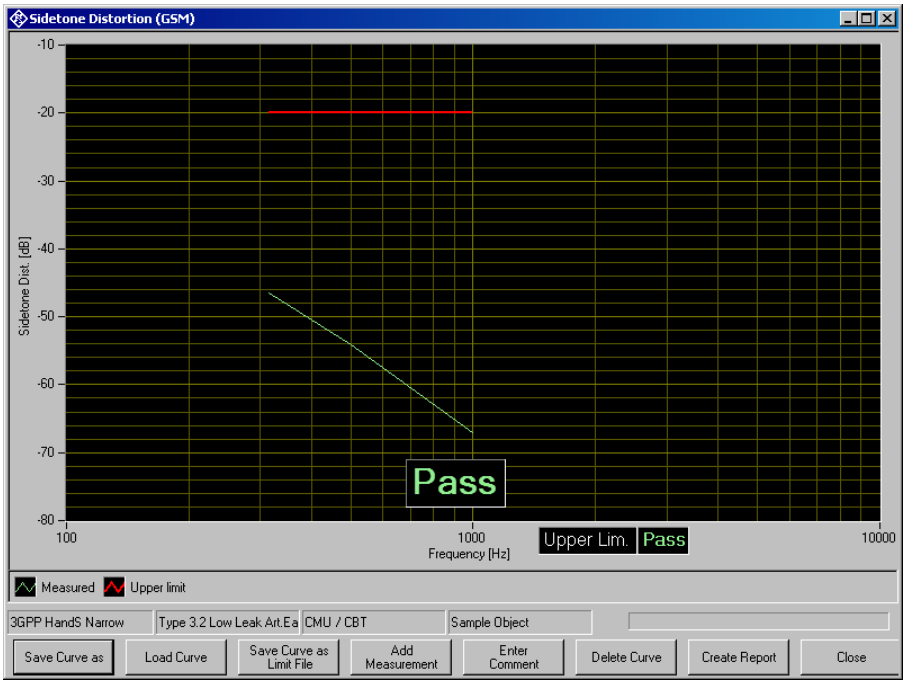


Fig. 113 Sidetone distortion test

Gain Variation Tests

Gain variation tests in sending and receiving direction are specified in 3GPP TS 43.050 Annex C.5. The limits given in TS 43.050, sections 3.9.1 and 3.9.2 are meant for measurement over DAI and cannot be fulfilled when a Codec is in the transmission chain. The configurable versions of the gain variation tests allow to define specific limit curves.

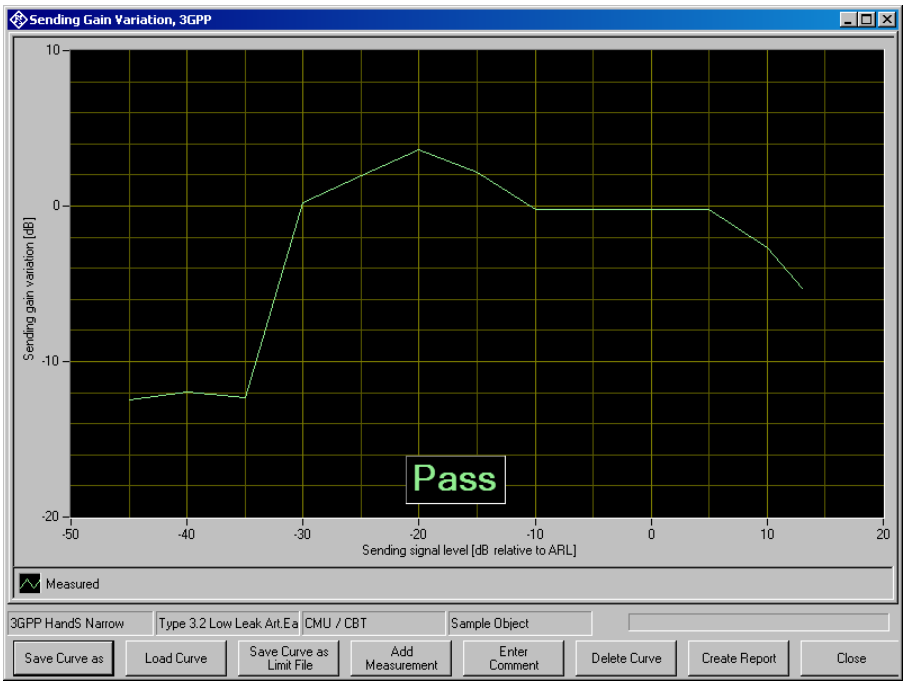


Fig. 114 Sending gain variation test

Delay Measurements

Sending and receiving delay can only be measured end-to-end, i.e. from the acoustic origin of the artificial mouth to the decoder output of the system simulator or from the encoder input of the system simulator to the DRP. The measurements offered with R&S UPV-K91 allow to subtract the estimated delay of the R&S CMU200 from the total measured value. As the data is interleaved on the air interface, no exact time instance can be determined when the audio data are transmitted between mobile phone and system simulator. The values used in the present measurements are estimations with an uncertainty of about 10 ms. The delay measurement is performed for a given set of frequencies, and an average is calculated over all frequencies.

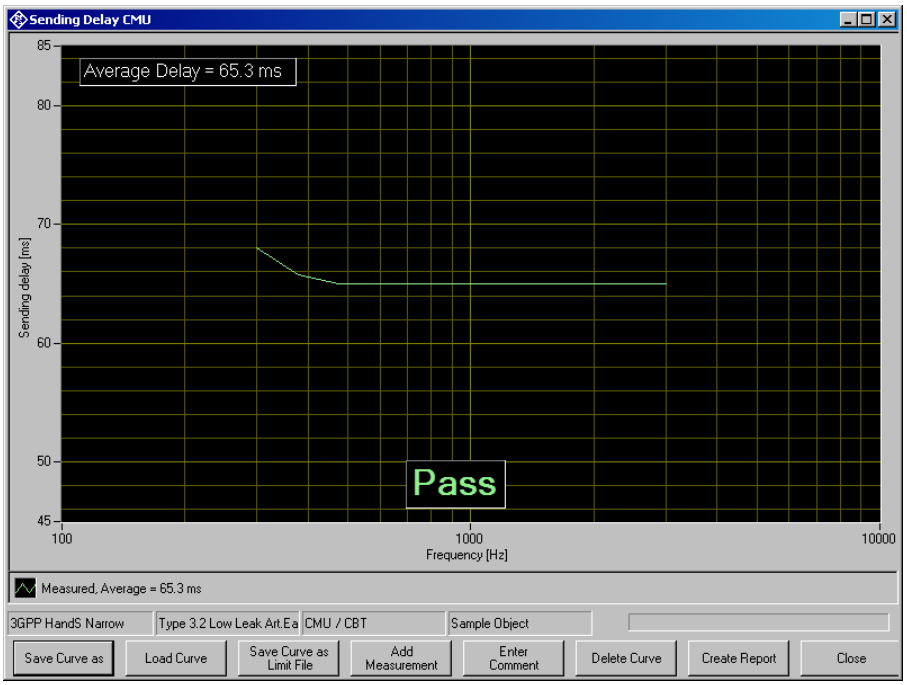


Fig. 115 Sending delay measurement

Background Noise Measurements

3GPP TS 26.132 demands the background noise in the test room to be below -64 dBPa(A) for idle channel noise measurements and below -30 dBPa(A) for all other handset measurements. For hands free measurements the background noise needs to be below -70 dBPa. The background noise measurements offered in R&S UPV-K91 check the overall noise level against these limits and display the spectrum of the noise. A lower limit assures that the test is not erroneously passed if no microphone is connected or the microphone supply is switched off. The test requires a diffuse field (pressure field) microphone to be connected to analyzer input 1 and to be placed in the test room, preferably at the place of the MRP.

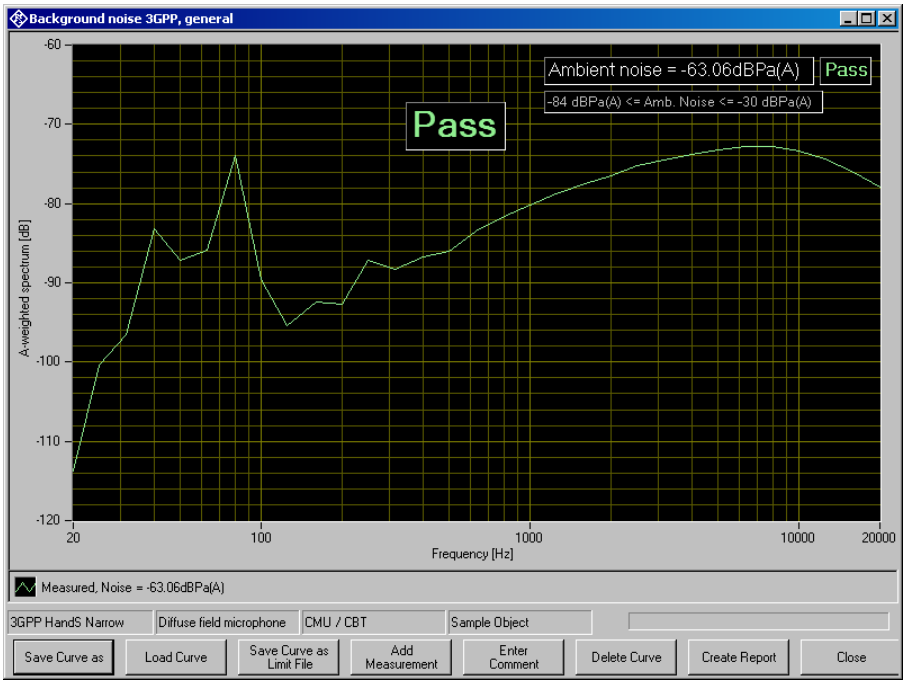


Fig. 116 Background noise measurement

If the noise in the test room does not fulfil the requirements it may first be attempted to remove noise sources in the vicinity of the test chamber. If no further reduction is possible, the sound isolation of the chamber should be improved. This can be achieved e.g. by heavier walls. Low frequency noise may possibly be conducted as structure borne sound, which may be reduced by an isolating support of the chamber. High frequency noise can be caused by a leakage e.g. at the door and may be reduced by an improved gasket.

6 Customizing Measurements

Measurements which implement a test case of a standard are locked and cannot be edited. However, for each measurement type there is also a configurable measurement provided, in which the limits can be customized. The parameters of the measurements are accessible through the menu item “Config. Meas.”

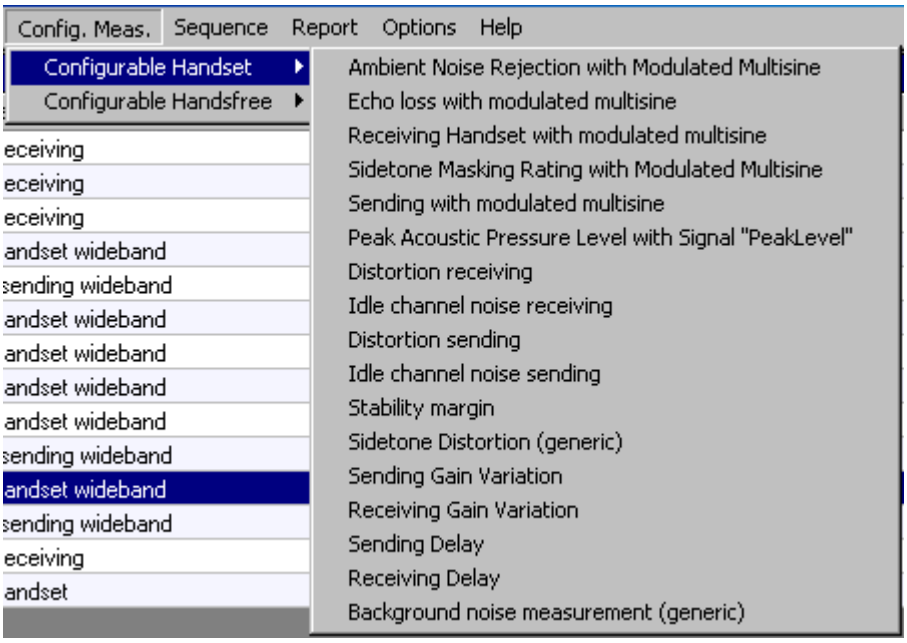


Fig. 117 Measurement configuration menu

Clicking on one of the entries opens a window in which all parameters can be viewed and most of them can be customized:

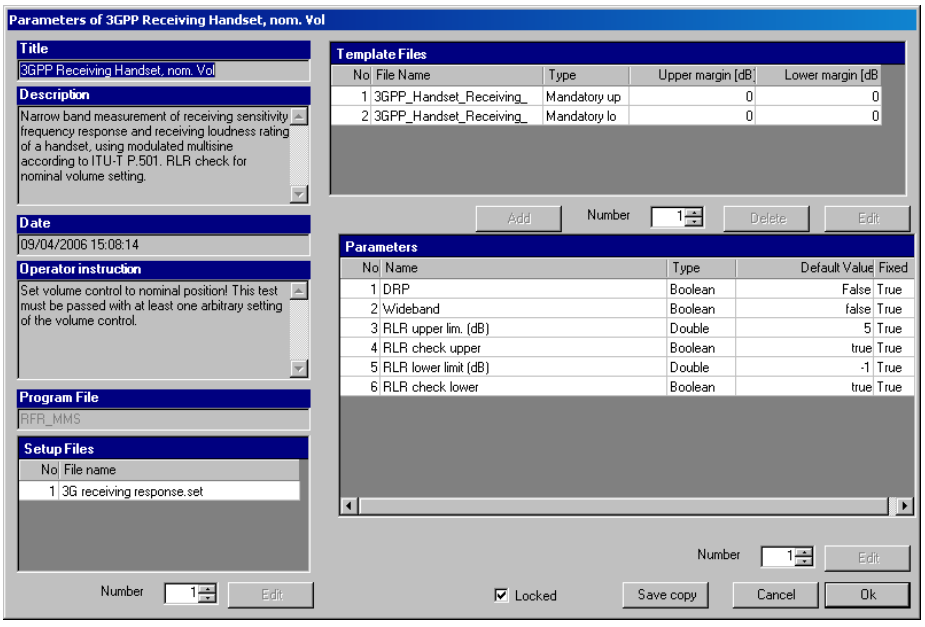

Parameters of 3GPP Receiving Handset, nom. Vol
Title
3GPP Receiving Handset, nom. Vol
Description
Narrow band measurement of receiving sensitivity frequency response and receiving loudness rating of a handset, using modulated multisine according to ITU-T P.501. RLR check for nominal volume setting.
Date
09/04/2006 15:08:14
Operator instruction
Set volume control to nominal position! This test must be passed with at least one arbitrary setting of the volume control.
Program File
RFR_MMS
Setup Files
No File name
1 3G receiving response.set
Number
Edit
Template Files
No File Name Type Upper margin [dB Lower margin [dB
1 3GPP_Handset_Receiving_ Mandatory up 0 0
2 3GPP_Handset_Receiving_ Mandatory lo 0 0
Add
Number
Delete
Edit
Parameters
No Name Type Default Value Fixed
1 DRP Boolean False True
2 Wideband Boolean false True
3 RLR upper lim. (dB) Double 5 True
4 RLR check upper Boolean true True
5 RLR lower limit (dB) Double -1 True
6 RLR check lower Boolean true True
Number
Edit
Locked
Save copy
Cancel
Ok

Fig. 118 Measurement parameters window

As Sequences create copies of the parameter files, each instance of a measurement in a sequence can have different settings which remain independent of the setting of this measurement in the main window and in other sequences. It is for example possible to compile a sequence with a number of stability margin tests having different loop gain.

The titles of the tests and the messages displayed to the operator before start of the measurement can also be edited in the “Parameters” window.

To facilitate copies of test definitions with small adaptations, it is possible to store a copy of the current parameter set under a different file name (button “Save copy”). Each measurement definition must have a unique title to be distinguished from other definitions like for example the original from which the copy was made.

For the purpose of making adapted copies it is possible to unlock a standard test definition (uncheck the “Locked” checkbox). In this case the “ok” button is disabled to avoid unintentional changes in standard tests.

All newly created test definitions appear in the last sub-menu of the “Standards” menu” (“More…”).

Editing Parameters

Parameters can be edited by entering their number in the “number” field below the data grid and clicking “Edit”.

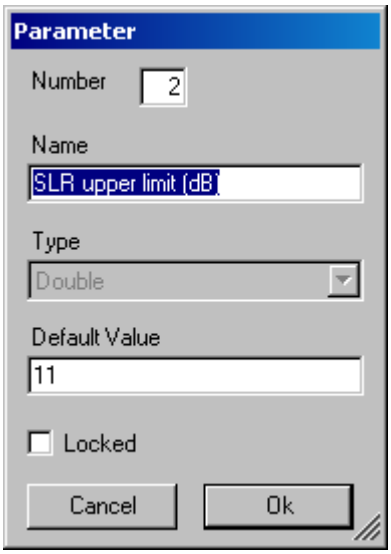


Fig. 119 Entry window for parameters

Note that the type conformity of the entered value is checked, but not the value itself against any range limits.

Editing Limit Curves

Clicking “Add” or “Edit” below the data grid for the limit curves opens the window for selecting limit files.

It is important to know that limit files have to start with the label “UPV LIMIT FILE” in the first line. They have to be ANSI coded, and the X and Y values have to be separated by a “TAB” character in each line.

Note that currently “Desired” limit curves are not supported in all test routines. Most of the measurement allow to specify either lower limits or

upper limits or both. An exception is formed by the sending response and receiving response measurements. As the limit template is centered around the measured curve with these measurements, upper and lower mandatory limits have to be specified pair-wise.

An existing limit file can be selected using the “browse” button. New limit files can be created by copying an existing limit file and editing the copy with a text editor (“Send to → Notepad” in the context menu of the file in the windows explorer). The number of data points on the curve must be specified in the “Datacount” line.

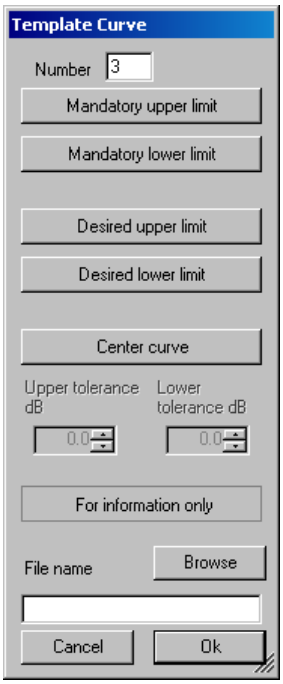


Fig. 120 Entry window for selecting limit curves

7 Measurements with electric connections

Introduction

Usually the mobile under test is connected via RF connection to the R&S CMU200 and via acoustic interfaces (artificial mouth and ear) to the R&S UPV. Therefore no intrusion in the mobile device is required.

There may, however, be cases during the design process of a mobile phone where the usual interfaces are not available:

- if a mechanic mockup is to be measured just with the acoustic components but without the rest of the circuitry
- if a circuit of a mobile phone is to be measured without acoustic components
- if a hands free kit or headset is to be measured without mobile phone
- if the hands free or headset connection of a mobile phone is to be measured without hands free kit or headset, respectively.

In these cases either coder and decoder or artificial ear and artificial mouth may be replaced by direct electrical connections to the R&S UPV. To use electric connections, select “Electric connection” in the respective item of the “Options” menu.

Calibration values for electric connections

Electrical connections cannot be calibrated. Instead a virtual sensitivity has to be entered for each type of electrical connection under “Calibration → Electric connections → …”.

Electric connection replacing artificial ear

R&S UPV Analyzer input 1 is directly connected to the earpiece amplifier output.

A nominal sensitivity of the receiver (earpiece speaker) for which the circuit is intended has to be entered in dB re 1 Pa/V.

Electric connection replacing artificial mouth

R&S UPV generator output 1 is directly connected to the microphone input of the mobile phone circuit.

A nominal sensitivity of the microphone for which the circuit is intended has to be entered in dB re 1 V/Pa.

Electric connection replacing encoder

R&S UPV generator output 2 is directly connected to a earpiece or headset speaker or to the speech input of a hands free kit.

A nominal full scale output voltage (output voltage corresponding to digital full scale) of the circuit intended to drive the speaker or car kit has to be entered.

Electric connection replacing decoder

R&S UPV analyzer input 2 is directly connected to a microphone or to the speech output of a hands free kit.

A nominal full scale input voltage (input voltage corresponding to digital full scale) of the respective microphone or speech input has to be entered.

Performing the measurements

After applying the settings in the “Options” menu and after entering appropriate calibration values for the electric connections in use, the measurements may be started as usual.

Some parts of the standard require the use of particular artificial ears for particular measurements. Therefore the checkbox “Allow only selected measurements” should be unchecked in “Options → Standard”.

For sending tests, the output voltage range in the R&S UPV is set to a large value in order to be able to drive the speaker of the artificial mouth. In rare cases sending distortion and/or sending noise results may be degraded with electric connections if a low microphone sensitivity is entered. In this case please contact R&S support.

8 Automatic Test Sequences

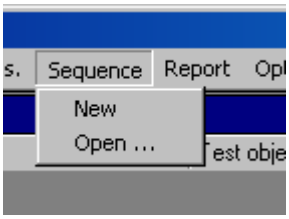


Fig. 121 Sequence menu

Creating and Editing a Sequence

The menu item “Sequence → New” first produces a window where a name for the new sequence has to be entered. Subsequently the sequence window opens.

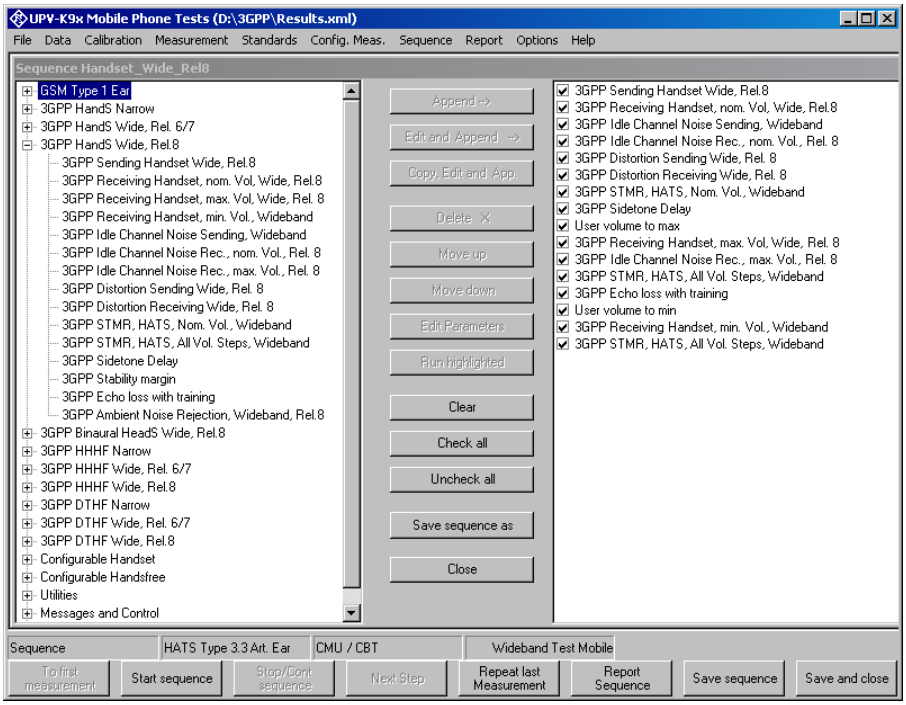

UPV-K9x Mobile Phone Tests (D:\3GPP\Results.xml)
File Data Calibration Measurement Standards Config. Meas. Sequence Report Options Help
Sequence Handset_Wide_Rel8
GSM Type 1 Ear
3GPP HandS Narrow
3GPP HandS Wide, Rel. 6/7
3GPP HandS Wide, Rel.8
3GPP Sending Handset Wide, Rel.8
3GPP Receiving Handset, nom. Vol, Wide, Rel.8
3GPP Receiving Handset, max. Vol, Wide, Rel. 8
3GPP Receiving Handset, min. Vol., Wideband
3GPP Idle Channel Noise Sending, Wideband
3GPP Idle Channel Noise Rec., nom. Vol., Rel. 8
3GPP Idle Channel Noise Rec., max. Vol., Rel. 8
3GPP Distortion Sending Wide, Rel. 8
3GPP Distortion Receiving Wide, Rel. 8
3GPP STMR, HATS, Nom. Vol., Wideband
3GPP STMR, HATS, All Vol. Steps, Wideband
3GPP Sidetone Delay
3GPP Stability margin
3GPP Echo loss with training
3GPP Ambient Noise Rejection, Wideband, Rel.8
3GPP Binaural HeadS Wide, Rel.8
3GPP HHHF Narrow
3GPP HHHF Wide, Rel. 6/7
3GPP HHHF Wide, Rel.8
3GPP DTHF Narrow
3GPP DTHF Wide, Rel. 6/7
3GPP DTHF Wide, Rel.8
Configurable Handset
Configurable Handsfree
Utilities
Messages and Control
Append →
Edit and Append →
Copy, Edit and App.
Delete X
Move up
Move down
Edit Parameters
Run highlighted
Clear
Check all
Uncheck all
Save sequence as
Close
3GPP Sending Handset Wide, Rel.8
3GPP Receiving Handset, nom. Vol, Wide, Rel.8
3GPP Idle Channel Noise Sending, Wideband
3GPP Idle Channel Noise Rec., nom. Vol., Rel. 8
3GPP Distortion Sending Wide, Rel. 8
3GPP Distortion Receiving Wide, Rel. 8
3GPP STMR, HATS, Nom. Vol., Wideband
3GPP Sidetone Delay
User volume to max
3GPP Receiving Handset, max. Vol, Wide, Rel. 8
3GPP Idle Channel Noise Rec., max. Vol., Rel. 8
3GPP STMR, HATS, All Vol. Steps, Wideband
3GPP Echo loss with training
User volume to min
3GPP Receiving Handset, min. Vol., Wideband
3GPP STMR, HATS, All Vol. Steps, Wideband
Sequence
HATS Type 3.3 Art. Ear
CMU / CBT
Wideband Test Mobile
To first measurement
Start sequence
Stop/Cont sequence
Next Step
Repeat last Measurement
Report Sequence
Save sequence
Save and close

Fig. 122 Sequence window

Initially the right checked list box is empty. The tree view box on the left side displays all available measurement definitions structured according to the standards, similar to their order in the “Standards” menu. A measurement is appended to the sequence by highlighting it in the tree view box on the left side and clicking the “Append” button. Subsequently a measurement, which is highlighted in the checked list box on the right side, can be moved within the sequence using the buttons “Move up” and “Move down” and deleted from the sequence with the “Delete X” button. For non-standard measurements which allow to change parameters like limit curves, it is possible to edit the parameters before appending the measurement to the sequence. This is done by clicking the button “Edit and append”. It is for example possible to assemble a test sequence which contains stability margin tests with different loop gains.

A sequence should be run with option “Show operator instructions” disabled. This avoids interruption of the execution. If a message to the operator is to be inserted into the sequence on purpose, e.g. “Set user

volume control to maximum!", the items provided in the tree view under "Messages and Control" may be used. Such a message will stop the execution of the sequence until it is closed by acknowledgement of the operator.

Remote Control of R&S CMU200 within a Sequence

It is possible to remote control radiocommunication tester R&S CMU200 from the R&S UPV within an automatic test sequence, for example to wait for a mobile to register, or for originating a call to the mobile. First the connection interface to the R&S CMU200 has to be set up using menu item "Options → CMU remote control". To insert a control instance into a sequence, choose one of the examples offered in branch "Messages and Control" of the tree view and edit it if necessary. For details on the remote control of the R&S CMU200 see the respective operation manuals.

Each control instance consists of a block of an arbitrary number of remote commands followed by a status query. The query command (e.g. "SIGN:STAT?") and the response to wait for (e.g. "SYNC" or "CEST") can be specified as well as a timeout for the case that the desired response is not received. As the R&S CMU200 is organized into subsystems for the different mobile phone systems / GSM bands, the subsystem has to be specified as a parameter. Parameter "Auto" causes the control instance to use the subsystem set with menu item "Options → CMU Subsystem". Note that for different GSM bands the remote commands are usually compatible, but they are not always compatible between GSM and WCDMA.

In addition, a message to the operator like "Please switch on the mobile!" can be entered in the "Operator Instruction" field of the parameter window. Parameter 1 allows to choose whether the message is shown before or after the block of commands is sent to the R&S CMU200.

When the R&S CMU200 control instance is executed within a sequence, a window opens, showing the progress of the control action.

Note: *By default, the R&S CMU200 changes its state when switching from local control to remote control or vice versa. As a consequence, synchronicity / registration or an established call would be lost during the transition. Therefore the command "SYSTem:GTRMode:COMPatible OFF" has to be issued before the first real remote control instance. Insert "CMU run this first!" in your sequence before any other remote CMU remote control.*

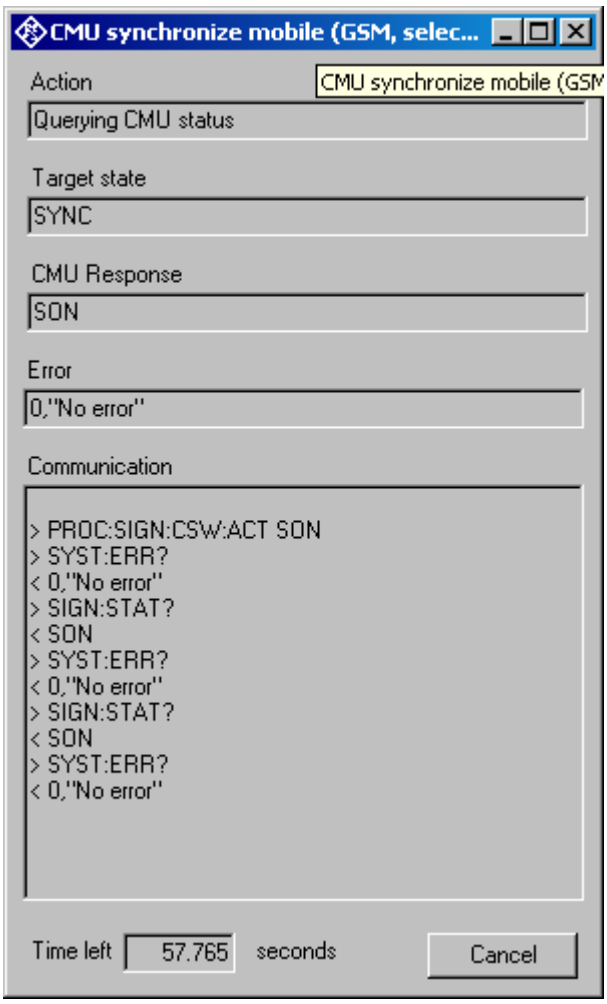


Fig. 123 CMU remote control window

"Action" shows the current remote control action. "Target state" shows the desired query response. "CMU Response" shows the actual response of the R&S CMU200 to the query. Error information returned from the R&S CMU200 after the last command / query is displayed in the "Error" field. The "Communication" box lists all commands and responses issued during the control process. During the status query, the box "Time left" shows the time left until the timeout expires.

Opening an Existing Sequence

The menu item "Sequence → Open …" opens a file selector for specifying the sequence to be loaded. The sequence file is usually found in a subfolder of D:\3GPP with the same name as the sequence. The sequence window opens with the specified sequence loaded. The sequence can then be edited and/or run.

Running a Sequence

When the softkey "Start sequence" is pressed, all checked measurements in the right list box are executed in sequence. The state of the checkboxes may be altered by marking a measurement and then clicking on the checkbox.

A running sequence may be interrupted with one of the buttons in the measurement control window which is visible while a measurement is

running. “Cancel and continue sequence” cancels the currently running measurement and resumes execution of the sequence with the next measurement. “Cancel and stop sequence” aborts both running measurement and sequence. “Stop sequence after this measurement” completes the running measurement and stops the sequence afterwards.

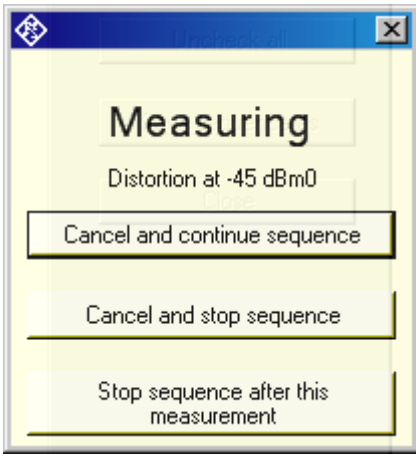


Fig. 124 Measurement control window

Running a Single Measurement out of a Sequence

A single measurement of a sequence may be started by highlighting the measurement in the right checked list box and clicking the button “Run Highlighted”.

Reporting on Sequence Results

A report on all executed measurements of the last run sequence is prepared and displayed after the “Report Sequence” softkey has been pressed. After the sequence window has been closed, a report on the last sequence can be obtained by pressing the “Report last sequence” softkey in the main window.

9 Reporting, Storing, Loading and Deleting Results

Result Files

Measurement results are stored together with all associated data in XML files. Separate files can be used for different projects or operators. They can be archived together with other project data and re-opened later for generating reports.

It is recommended to keep result files small and to generate backups at frequent intervals.

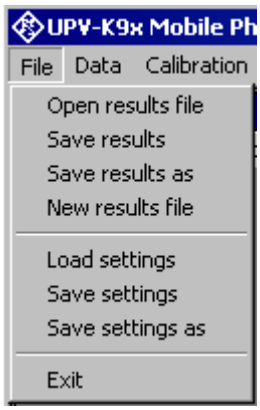


Fig. 125 File menu

A new (empty) result file can be created with “File → New Result File” from the main menu.

An existing result file can be opened with “File → Open Result File” from the main menu.

A currently opened result file can be stored under a new name with “File → Store results as” from the main menu.

Report Settings

With “Report → Settings” or “Options → Report settings”, a selection can be made of data which should appear in the reports. Thus, information which is the same for a larger number of measurements does not have to be printed with every report again.

The size of diagrams in the report can be scaled between 100% (approx. page width) and 50%.

Generating a Single Report

A report on a single measurement result can be generated from the window of a measurement macro by clicking or pressing the softkey “Generate report”.

From the result overview of the main window, a report on a single measurement can be generated by marking the row with the selected result by clicking on the row header to the left (see Fig. 12), right-clicking into the data grid and selecting “Generate report” from the context menu.

Subsequently data associated with the selected measurement is assembled, a graph for existing curve data is generated, and the preview window is opened. Depending on the amount of measurement data, this may take a few seconds.

Generating a Sequence Report

A report on a sequence of measurements can be generated from the sequence window by clicking or pressing the softkey “Report sequence”.

Once the sequence window has been closed, a report on the last executed sequence can be generated by selecting “Report → Last sequence” from the main menu. Reports about previous sequences can be generated as single reports on the measurements of this sequence, as all results appear in the overview data grid in the main window.

Selection Report

A report on a selection of measurements can be generated from the results overview data grid in the main window by marking the rows with the desired results in the “Select” column and choosing item “Report Selection → Report Selected Results” (see Fig. 11). Rows marked with “XXXXX” in the “Select” column will be added to the report. The selection can be toggled by clicking into the respective “Select” cells. Note that another cell must be clicked before the same cell can be toggled again.

Preview Window

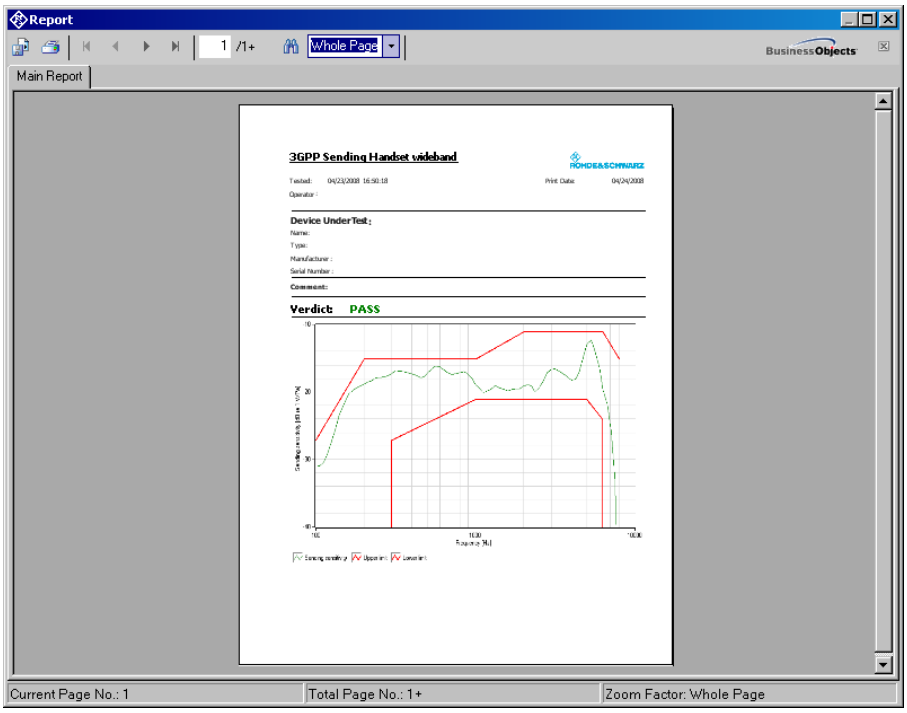


Fig. 126 Report preview window

The main area of the preview window shows a preview of the report as it will be printed or appear in an exported PDF file. If the report comprises more than one page, the pages can be browsed using the buttons

To open the print dialog for installed windows printers click

To open a file selector for export of the report to PDF, WORD, EXCEL or Rich Text format, click

The scale of the document in the preview can be adjusted with

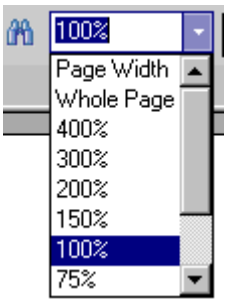


Fig. 127 Scale menu of the preview window

Storing and Loading Curves

Measured curves can be stored from and loaded into the graph of a measurement macro (see above). This allows easy import into spreadsheets as well as direct comparison of curves measured at different times or places. Measured curves can also be stored in a R&S UPV limit file for use as a limit curve either in a R&S UPV sweep graph or in the graph of a R&S UPV-K9/K91 window. This allows e.g. to derive tolerance schemes from “golden devices”. The measured curve can be arbitrarily shifted before being stored.

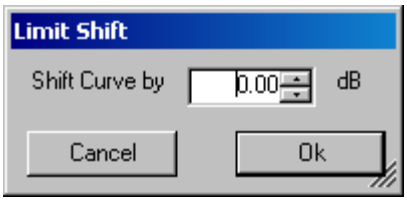


Fig. 128 Input window for defining a shift of a measured curve for storage as limit curve

Furthermore curves can be exported from the main results window by marking the result in the data grid, right-clicking on it and choosing the item “Save curve of selected row as …” in the context menu.

ASCII Result Files

When the item “Generate temporary export files” in the “Options” menu is checked, the standard tests generate “curve.exp” or “abscurve.exp” and “relcurve.exp” and “result.exp” files similar to those generated by R&S UPL-B9. These files are always deleted and overwritten by subsequent tests.

This feature is provided only for compatibility reason. It is not available in all measurement types.

Deleting Results

It may be desirable to delete results of selected measurements from the result file, e.g. because the measurement was repeated due to a missing call to the mobile, a wrong setting etc. To delete the result of a particular measurement, mark the row for the selected measurement in the data grid of the main window by clicking on the row header to the

left, right-click into the data grid and select “Delete result” from the context menu. After confirmation by the operator, the selected row of the result overview will be deleted from the result file together with all associated data.

A set of results may be selected in the “Select” column of the results data grid and commonly deleted using the context menu item “Report Selection → Delete Selected Results”.

10 Remote Controlled Start of Testcases via GPIB

Preparations

- Start the K9x test program on the R&S UPV.

- In the “Options” menu, deactivate item “Show operator instructions” and activate “Generate temporary export files”.

- If it is desired to download screenshots from the R&S UPV to the host, activate also “Generate temporary image files” in the Options menu.

- Activate “Enable remote control” in the Options menu

- Do all necessary settings and calibrations as would be done for manual control.

Starting a Measurement

A measurement can be started with remote command:

SYST:PROG:EXEC
'C:\ControlK9.exe D:\3GPP\3G_rec_handset_narrow_max.mdf'

wherein “ControlK9.exe” is the client program controlling the application and “D:\3GPP\3G_rec_handset_narrow_max.mdf” specifies a file which defines the test to be executed. A list of files for various tests is given separately in the spreadsheed file “TestCaseList_23147.xls”. The file name must be separated from the program name by a space character. Thus it is recognized by the client program as a command line parameter.

Attention: Do not attempt to control the UPV-K9x software locally while a remotely started test case is running.

Reading the Results

Result values and curves are available in memory buffers in the R&S UPV firmware according to the following tables:

Table 4 Assignment of string buffers for result values

String Buffers	
1	Title <Tab> Date <Tab> Time
2	Total verdict
3	Result 1 heading
4	Result 1 value
5	Result 1 verdict
6	Result 2 heading
7	Result 2 value
8	Result 2 verdict
9	Margin 1 (upper) heading
10	Margin 1 (upper) value
11	Margin 2 (lower) heading
12	Margin 2 (lower) value
13	Margin 3 heading
14	Margin 3 value
15	Margin 4 heading
16	Margin 4 value
17	Delay heading
18	Delay value
19	Error message
20	Result 3 heading
21	Result 3 value
22	Result 3 verdict
23	Result 4 heading
24	Result 4 value
25	Result 4 verdict
26	Result 5 heading
27	Result 5 value
28	Result 5 verdict
29	Result 6 heading
30	Result 6 value
31	Result 6 verdict
32	Result 7 heading
33	Result 7 value
34	Result 7 verdict

String buffers can be queried using the remote command

SYSTem:MEMory:STRing<i>?

Table 5 Assignment of trace buffers for result curves

Trace Buffers	
1	Result 1 (absolute) curve X values
2	Result 1 (absolute) curve Y values
3	Result 1 shifted / upper limit X values
4	Result 1 shifted / upper limit Y values
5	Result 1 lower limit X values
6	Result 1 lower limit Y values
7	Result 1 relative curve X values
8	Result 1 relative curve Y values
9	Result 2 (absolute) curve X values
10	Result 2 (absolute) curve Y values
11	Result 2 shifted / upper limit X values
12	Result 2 shifted / upper limit Y values
13	Result 2 lower limit X values
14	Result 2 lower limit Y values
15	Result 2 relative curve X values
16	Result 2 relative curve Y values

Trace buffers can be queried using the remote command

SYSTem:MEMory:DATA<i>?

Results are also available in files “D:\3GPP\result.exp”, “D:\3GPP\relcurv.exp” and / or “D:\3GPP\abscurv.exp”, depending on the type of measurement. If “Options → Generate temporary image files” is activated, a screenshot of the last finished test is available in “D:\3GPP\Image.TIF”. The command for the file transfer is (for the example of the results file)

MMEM:DATA? 'D:\3GPP\result.exp '

All results are stored in the database. However, it is not possible to change the test object remotely. The results can be identified later by the test time given in the “result.exp” file.

Determining the Termination of a Measurement

A running test is indicated with bit 13 of the Operation register in the status system set. It is recommended to configure a service request on the GPIB for a negative transition of this bit:

STAT:OPER:NTR 8192

STAT:OPER:ENAB 8192

*SRE 128

A service request will be issued as soon as the test has terminated.

To avoid obsolete result files to be downloaded from the R&S UPV, existing result files can be deleted before the start of the measurement, using the commands:

MMEM:DEL 'D:\3GPP\result.exp'

MMEM:DEL 'D:\3GPP\relcurv.exp'

MMEM:DEL 'D:\3GPP\abscurv.exp'

Note that an attempt to delete a non-existing file will lead to an entry in the error queue. The error queue can be flushed using the query “SYST:ERR?” until the response is ‘0,”No error”’. Alternatively existing files can be overwritten by uploading empty files with the same name. Downloaded files can then be checked for their size before they are processed further, to determine whether they are empty dummy files.

For further details on remote control of the R&S UPV via GPIB and on the remote commands mentioned above please see the user manual of the R&S UPV.

11 Terminating the Application

The measurement can be terminated from the main window with the “Exit” softkey. This causes the result file to be written to the hard disk.

Please allow a few seconds for the results file to be written before shutting down windows.

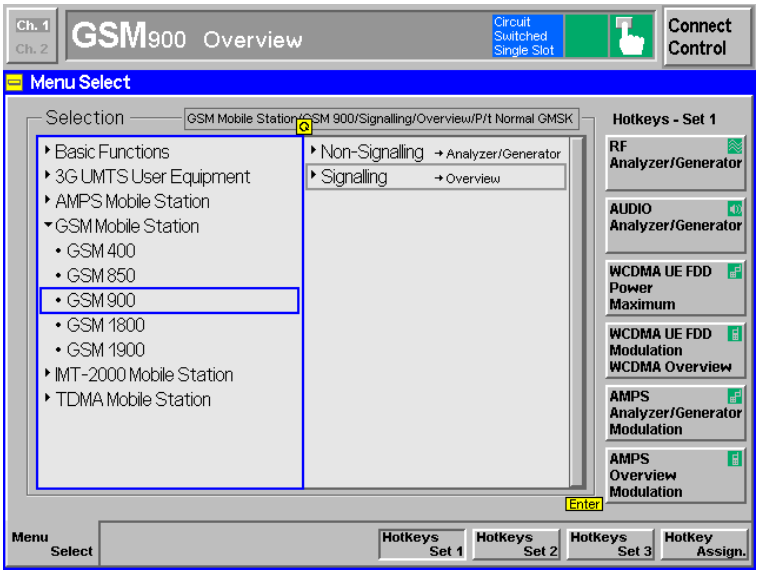
Do not shut down the instrument before the application program has been closed.

Appendix A Settings on the Radio Communication Tester R&S CMU200

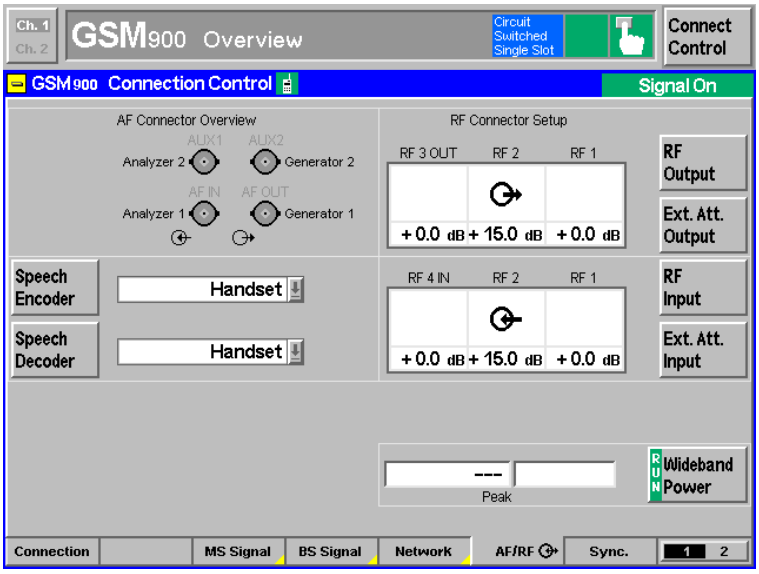
Firmware 4.52

Settings for GSM:

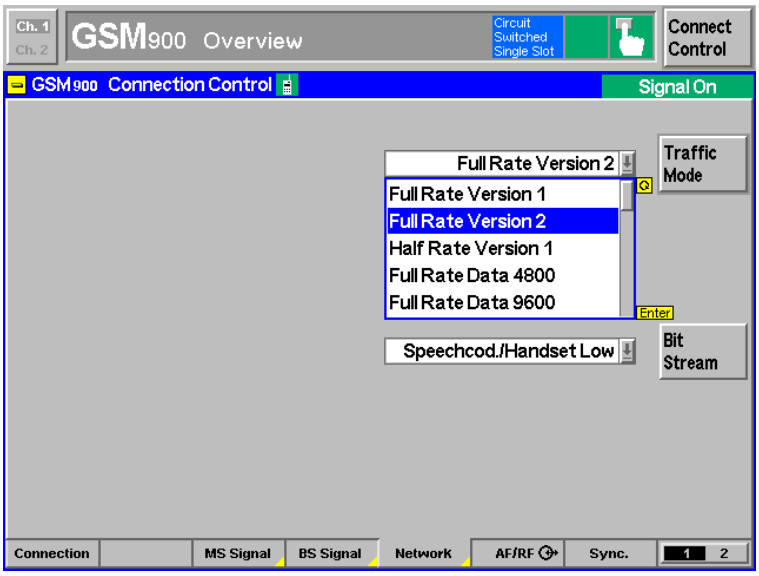
Selection of the GSM band:

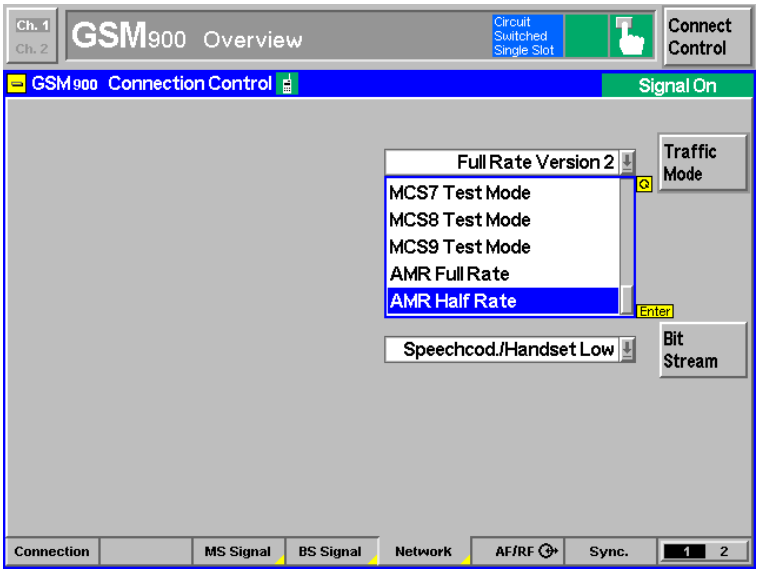


Taking a coupling loss of the antenna coupler into account:

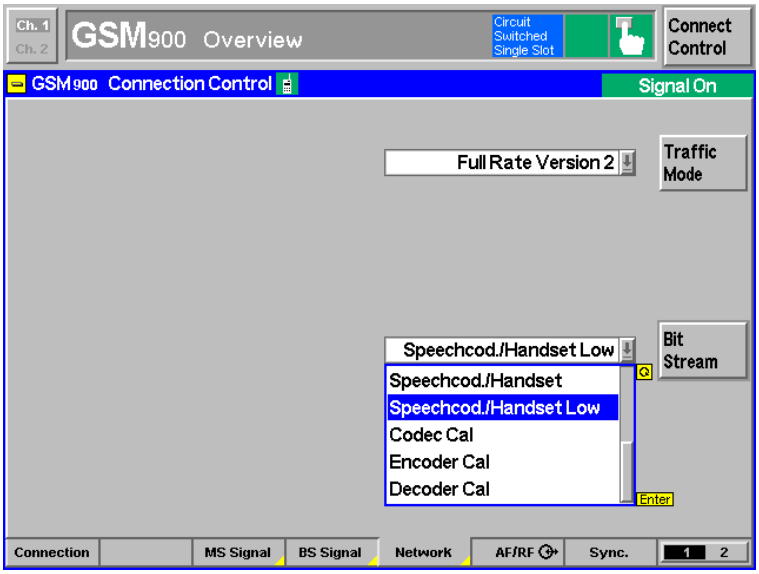


Select EFR (full rate version 2), HR (half rate version 1), AMR full rate or AMR half rate speech coder. 3GPP TS26.132 specifies AMR at 12.2 kbit/s which is identical with full rate version 2:

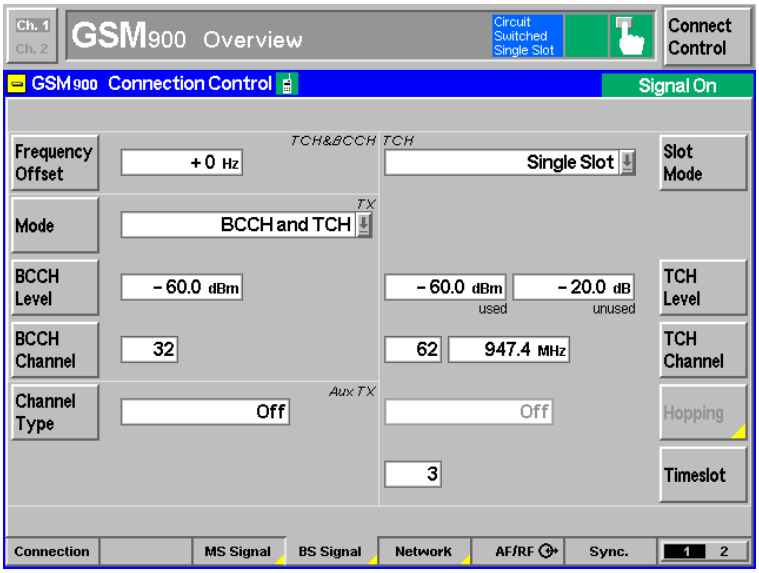




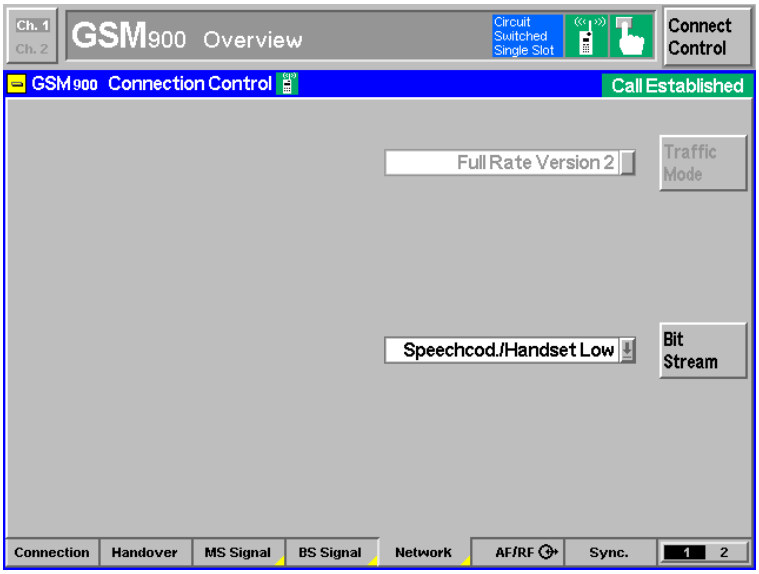
Selection of the Bit Stream Handset Low setting for the measurements or Decoder Cal and Encoder Cal for the calibration:



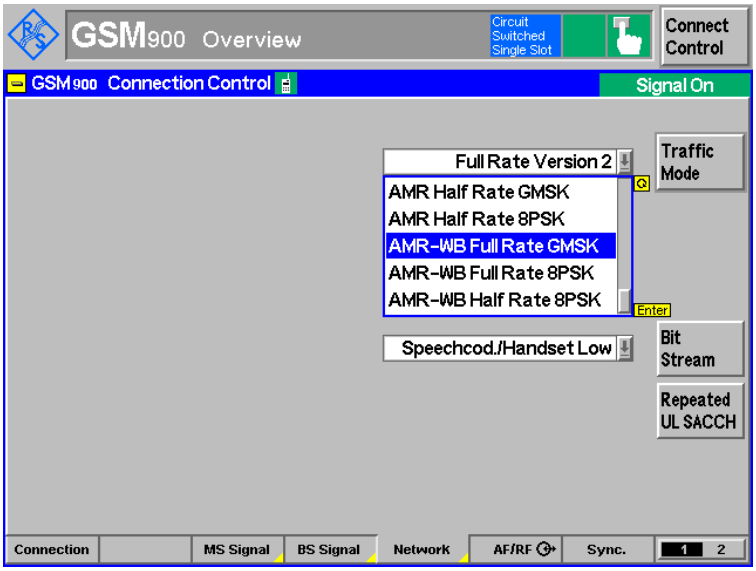
Setting of the desired TCH and BCCH levels:



Typical setting with EFR speech coder (corresponds to AMR 12.2) for measurements in the call established status:

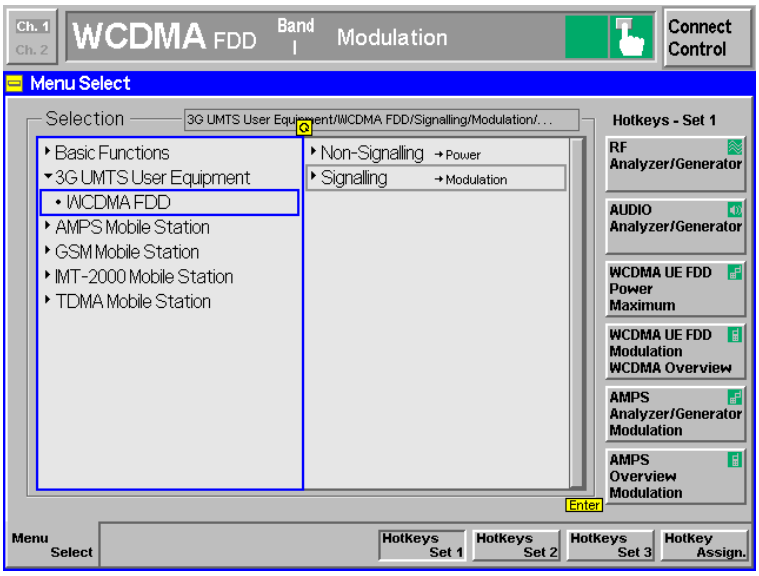


Settings for WB-AMR:

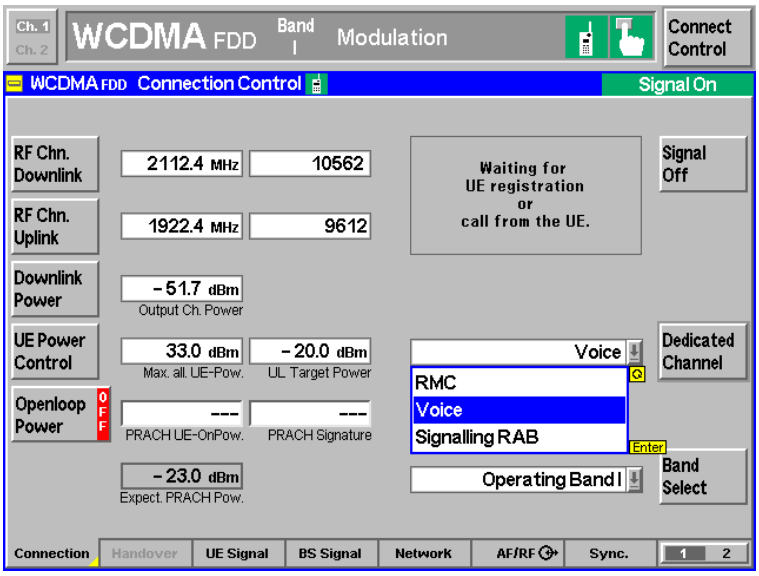


Settings for UMTS WCDMA FDD:

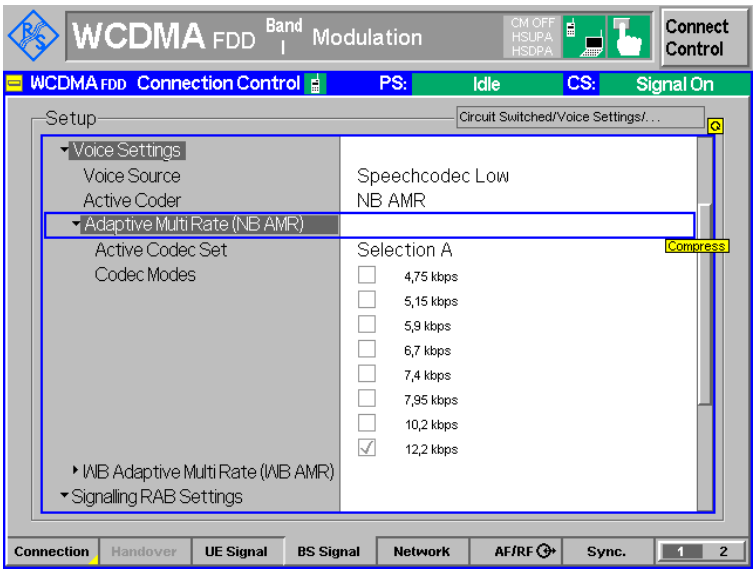
Selection of mode:



Setting dedicated channel to voice:

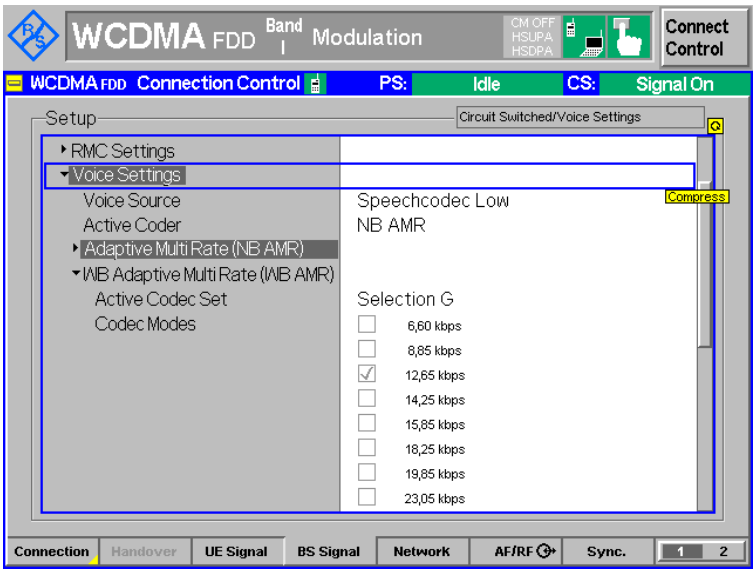


Selection of the Narrowband AMR Speechcodec Low setting and AMR Bit Rate for the measurements or Decoder Cal and Encoder Cal for the calibration (selection is possible only if call is deactivated):

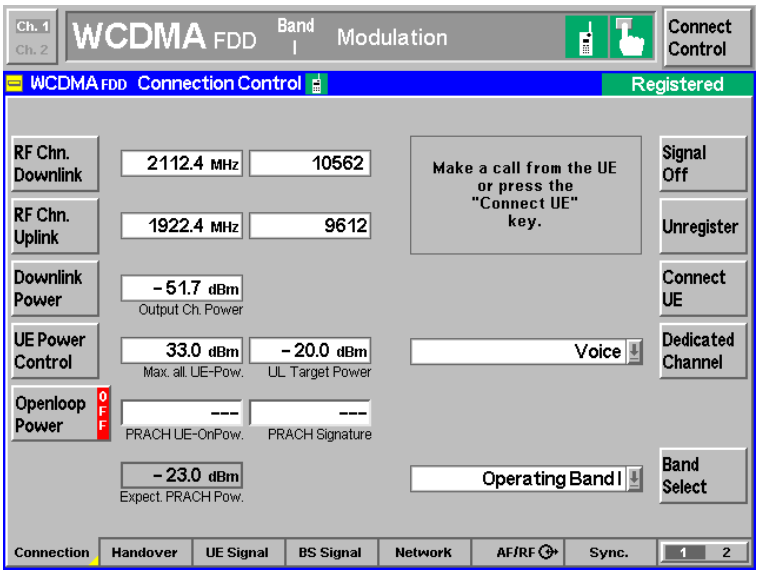


3GPP Ts 26.132 specifies 12.2 kbps bit rate for audio testing with the NB AMR codec.

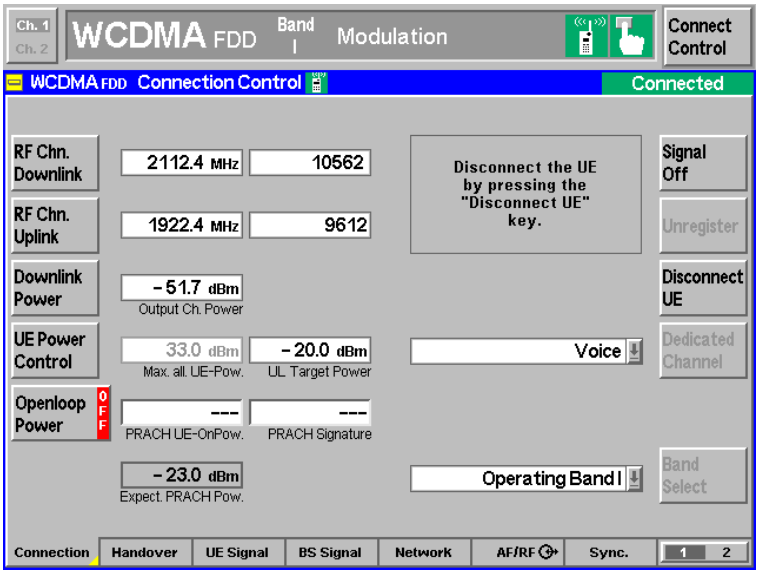
Selection of the Wideband AMR Speechcodec Low setting and AMR Bit Rate for the measurements or Decoder Cal and Encoder Cal for the calibration (selection is possible only if call is deactivated). For the sake of consistency with Wideband AMR tests in GSM, 3GPP TS 26.132 specifies 12.65 kbps for audio with the WB AMR codec:



Mobile phone registered status, codec settings possible:



Call active (connected) status for the measurements:



Appendix B Troubleshooting

Error message 2908 during installation

Please contact customer support.

Damaged setup file is reported

If the program is unable to load the latest setup file, it will automatically offer to restore a backup of the damaged file. Only if there is no backup available, or loading of the backup fails again, the following procedure can be applied:

Copy “Settings.sup” from C:\Program Files\Rohde&Schwarz\UPV-K9x Mobile Phone Tests” to “D:\3GPP”, overwriting the damaged file of the same name. Alternatively, “D:\3GPP\settings.sup” may just be deleted. Subsequently all settings in the “Options” menu have to re-done and for all used calibration types calibrated devices have to be selected again.

Damaged results file is reported

There are backup files available of the file containing the test results, with appendix ~1 and ~2 to the file name of the results file (usually “D:\3GPP\Results.xml”). If the results file cannot be opened for some reason, the program automatically offers to restore the latest backup file.

If this does not work, a backup file can be renamed by removing the respective ~1 or ~2 extension, and opened subsequently. It is recommended to store the damaged results file under a different name.

A test is not starting properly

Re-select devices for the calibration types required for the respective test, using menu item Calibration → Select device. If this does not solve the problem, copy all files from “C:\Program Files\Rohde&Schwarz\UPV-K9x mobile phone tests\3GPP files\Overwrite” to “D:\3GPP”, overwriting the existing files therein.

A calibration value is missing or no device is selected for a required calibration type

If re-selecting the calibration device and re-calibrating it does not help, create a new device with “Calibration → New device”. Tick the “Immediately select this device” box before clicking the “Ok” button and do the calibration for this device. All selected devices and their calibration values can be checked with “Calibration → Show selected devices”.

The receiving noise test produces an overrange error

Reduce the gain of the conditioning amplifer in the signal path of the artificial ear, re-calibrate the artificial ear and re-try the test.

ARL for the sending distortion test cannot be adjusted

First, try a sending test to see if the connection to the mobile is existing. If the RLR value is too high, the sending sensitivity of the mobile under test may be too low to adjust the ARL. If there is no signal in the sending test (SLR > 60 dB) check the connection between R&S CMU200 and mobile. If no signal from the artificial mouth is audible during the sending test, check the signal path between R&S UPV and artificial mouth. Re-calibrate the artificial mouth.

A measurement using a custom limit curve produces an error

Limit files must start with a line containing “UPV LIMIT FILE”. They must be stored as ASCII files with ANSI coding. Any other coding will produce an error. X and Y values must be separated by a TAB character. Using space characters instead of a TAB character will produce an error.

Other problems of unknown reason

If the problem cannot be solved with the information given above, the folder “D:\3GPP” can be renamed or deleted. At the next start of the application, this folder is created anew with all files in default state.

Attention: *Store a backup copy of the results file in a different folder before deleting “D:\3GPP”.*

Note: *Subsequently all settings in the Options menu and all data entries have to be re-done, all calibrated devices have to be created and calibrated again.*